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"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

THURSDAY, SEPTEMBER 2, 1915.

THE EXAMINATION OF HYDROCARBON OILS.

The Examination of Hydrocarbon Oils and of Saponifiable Fats and Waxes. By Prof. D. Holde. Authorised translation from the fourth German edition by Prof. E. Mueller. Pp. xv + 483. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 21*s.* net.

THE important part played by liquid fuel, both for steam raising and in the internal combustion motor, has focussed a large amount of attention upon the examination of hydrocarbon oils for commercial use, whilst the many "cracking" processes that have been introduced to supplement the supply of the lighter fractions of petroleum for motor purposes have considerably increased the interest felt in the somewhat involved actions, partly analytic and largely synthetic, that under the influence of heat and pressure bring about such profound changes in the characteristics of the oils.

Under these conditions any book dealing with the analysis of such oils would have been welcomed, and Dr. Holde has made the fourth edition of his work on the examination of hydrocarbon oils more attractive and at the same time more useful by introducing chapters on the tars obtained by the distillation of coal, lignite, shale, and peat, on saponifiable fats and the technical products prepared from them, and on waxes.

The first chapter occupies more than half the book, and deals with petroleum and petroleum products. After touching upon the occurrence, chemical composition, and formation of petroleum, there is an excellent section on its physical examination, followed by one on its chemical treatment, in which the flash-point is apparently given as the measure of the inflammability of the oil, the paragraph being headed "Inflammability," whilst a few pages later another paragraph is devoted to "Burning Point." The chemist knows perfectly well what is meant by flash and burning points, but the non-initiated, when told that naphtha has a flash point of $-21°$ C. and a burning point of $-19°$ C., gets an uncomfortable feeling that the material is too inflammable to have anything to do with, and before it is possible to clear up properly the muddlement that these terms have created it will be necessary to determine the igniting points of the various hydrocarbons present in petroleum, which vary from 400° C. to 700° C.

In dealing with the calorific value of naphthas for internal combustion motors the reader is told that "it is determined in a bomb," but no details are given as to how the dangers and difficulties of such a determination with a highly volatile spirit are to be got over. In discussing Hensler and Engler's combustion method for the determination of sulphur in oils, the dweller in a manufacturing town will be amused to read that since the laboratory air often contains sulphur, the tubes to supply the air for combustion are led into the open air; as 10 to 12 grams of oil are burnt in five hours, the sulphur from the air of even London would amount to more than the oil probably contained.

In many technical applications the book is scarcely up to date; for instance, we are told that "an attempt has been made" to cover the surface of roads with tar or oil, and later, "the tar applied hot is brushed into the street." The reader is also informed on p. 44 that "the gasoline used in pleasure vehicles should have no more than 5 per cent. of those components which boil

above 100° C., since otherwise the engine will frequently misfire"; considering that Pratt's spirit usually gives a little under 60 per cent., distilling below 100° C., and many petrol substitutes considerably less, this seems a misleading statement.

On p. 45 we are told that "the vapour pressure must be considered in storing naphtha and other inflammable liquids," but it is now being recognised that the determination of this factor is also of the greatest importance in forming a sound conclusion as to the ease of starting and flexibility in running with a motor spirit, as the amount of vapour given off at atmospheric temperatures governs the formation of the explosive mixture in the cylinder when starting from cold.

Directions are given for determining the vapour tension by introducing the petrol into the Torricellian vacuum above the barometric column in a 10 mm. diameter tube, but a far more simple and practical method is to use the pressure tube devised by Sir Boverton Redwood and Captain Thomson, which is adopted for testing the pressures developed in vessels containing petrol.

Several pages are devoted to the viscosity of oils and testing their lubricating value, and also to the setting point and fluidity of oils, their value for gas-making and tendency to resinification.

The book is, like most of the technical works of German origin, a model of abstracting, and invaluable as giving full references to original work, but its utility is discounted in the laboratory by the absence of practical detail.

Chapter ii. is devoted to natural asphalt, and contains much useful information on the subject; chapter iii. deals with ozokerite and Montan wax; whilst in chapter iv. we come to the important subject of the tars obtained by the distillation of coal, lignite, shale, and peat.

The attention devoted to the recovery of the coal-tar products in Germany led one to hope that this part of the book would contain much valuable information, but unfortunately the subject is not treated very fully, and points of such importance as the differences in tars due to variations in the temperature of carbonisation receive but scanty notice, whilst the use of the products of tar distillation is dismissed with the curt remark that "these are of great importance in the preparation of dye-stuffs and of pharmaceutical products." It might have been expected that special attention would have been devoted at the present time to the detection, estimation, and purification of those tar products used in the production of high explosives, but even the fact that it is the source of the most important explosives of the day is not mentioned.

The saponifiable fats and their technical products are a very useful section of the book, which ends with a chapter on waxes. Prof. E. Mueller is to be congratulated on the translation of the original German work, and the type, illustrations, and general style are of the excellence always found in Messrs. Wiley's technical publications.

ELECTRICAL ENGINEERING.

(1) *Continuous-current Electrical Engineering.* By W. T. Maccall. Pp. viii+466. (London: University Tutorial Press, Ltd., 1915.) Price 10*s.* 6*d.*

(2) *Single-phase Electric Railways.* By E. Austin. Pp. xiv+303. (London: Constable and Co., Ltd., 1915.) Price 21*s.* net.

(1) MR. MACCALL'S book is well above the standard usually found in books which cover such a wide field, and it can be thoroughly recommended, both to engineers and to students. To the latter, the large selection of questions will be of especial value. The book covers the ground indicated by its title about as thoroughly as could be expected in a volume of its size and price; the most noteworthy omission is the subject of primary batteries. More might have been said about electric heating, a little about electric cooking, and electric furnaces might at least have been mentioned.

The chapters on illumination and lamps are very good indeed, and contain little that we would wish to alter. But those on machines, although quite up to the standard of most text-books, are certainly less satisfactory. Here and there the matter is rather weak. Thus the portion dealing with generator characteristics does not show that real grip of the subject which an instructor ought to have. Another point is the geometry of the armature winding diagrams. A developed diagram is shown with the poles behind, the commutator *below*, and the numbers running from left to right; while a radial diagram has clockwise rotation of the numbers. These are not consistent with one another.

We do not think the author has ever tried to separate the no-load losses of a machine in any of the ways he has described, or we should have seen some doubts expressed as to the validity of some of them. In fact, he would probably have found, as we ourselves once did, that the "friction" alone, as determined from the constant speed experiment, *exceeds* the "friction + hysteresis" given by the constant flux experiment. In short, this method won't work, for it assumes that the frictional torque is the same at all speeds, which is very far from the truth. The running down test can be carried out much more simply than in the manner described, and it can be modified

so as to give a complete analysis of the losses in about half an hour after getting the machines into a steady condition.

We are flattered by the graceful acknowledgment that our mode of numbering the illustrations has been adopted, but we would have greatly preferred that in a much more important direction the author had followed the methods we advocate, but cannot claim to have originated. We refer to the practice of making the algebraic symbols stand for *things* and not merely for numbers, so that the formulas will apply irrespective of units. Mr. Maccall seems unable to discuss principles apart from some particular units, with the result that his mathematics is horribly complicated by numbers which have nothing to do with the facts, but arise from the unfortunate, although perhaps customary, choice of units. In some cases we are treated to separate deductions of formulas for inch and metric measure, instead of one formula with two sets of constants. As we said on a former occasion, the laws of nature were exactly the same ages before man ever discovered anything about them, much less invented units in which to express his measurements concerning them. *Make the symbols stand for things and the units will look after themselves.* Formulas will then represent *facts*, and not merely particular numerical relations.

We like the author's special symbol for "number of turns," but we object to making his other new symbol do double duty by using it both for "current × turns" and for the name of the unit "ampere-turn."

For the new edition, which we confidently expect, we hope that the publishers will adopt a paper suitable for reproducing the half-tone blocks. Fortunately, these form only a small proportion of the illustrations, but where they do occur they entirely spoil the appearance of the book, while at the same time they are seldom sufficiently distinct to be of any real use.

(2) "Single-phase Electric Railways" gives an outline description, with leading data, of all the important lines of this type which have so far been constructed. Although most of the matter has already been published in the columns of the *Engineer*, it is convenient to have it all collected together for ready reference. For that reason, it is unfortunate that the author has decided not to deal fully with the motor itself, and also that he has not included a great deal more data regarding the operating costs, of which much has been made public during the past few years.

The book is abundantly and well illustrated by drawings and photographs; indeed, the latter take such a very prominent place as to almost form the *raison d'être* of the book. The overhead construction is taken in fairly full detail, but the particulars of the motors and controlling gear are somewhat meagre. Diagrams of connections are certainly there, but the written description is generally too slight, except for the expert.

The first chapter of three pages is mainly historical, but just touches on the thorny battle of the systems. More eloquent than all the opinions of the author and the experts is the fact, brought out in a recent number of the *General Electric Review*, that since the advent of the high-voltage continuous-current system, the mileage of single-phase railways has been practically stationary, while that of the continuous-current system has gone up by leaps and bounds, and now far surpasses its rival. It would have been far better if this chapter had given an account of the general principles underlying single-phase railway working, and a closely reasoned account of the difficulties arising from it, the way in which these have been overcome, and the relative advantages and disadvantages of the system. A comparison of the solutions found for these difficulties in the various lines described further on would have served to weld the book into a homogeneous whole, instead of leaving it in twenty-three watertight compartments (one for each line described), with no connection between them but the common title to the whole book.

We may conclude by saying that to the expert and to the student of railway engineering, the book will be of especial value as a work of reference, diminished although that is by the lack of references to other publications. Others may find it interesting, for the style is good and the matter is made as readable as a catalogue (for such it really is) well can be. DAVID ROBERTSON.

THE LIMITATIONS OF SCIENCE.

(1) *The Limitations of Science.* By Prof. L. T. More. Pp. vii+268. (New York: H. Holt and Co., 1915.) Price $1.50 net.

(2) *The Magic of Experience.* A Contribution to the Theory of Knowledge. By H. Stanley Redgrove. Pp. xv+111. (London: J. M. Dent and Sons, Ltd., 1915.) Price 2*s.* 6*d.* net.

(1) PROF. MORE has written a study from a conservative point of view of the limitations of science as shown in modern physical views. "Will the results of experiment made objectively which must, however, be interpreted subjectively, fail in their turn as criteria of truth?" (p. 2). "Science, . . . like philosophy, has no ontological value. Should not the men of science clearly recognise this fact, and confine

their effort to the legitimate function of science—the discovery of natural phenomena and their classification into general laws by logical mathematical processes?" (p. 31).

The account of the growth of the mechanistic view in science and of atomism, and the criticism of them and development of a science of energetics by Rankine, Mach, Duhem, and Ostwald, are fairly adequate, and direct attention to some points—notably in Rankine's attitude—which have been forgotten by most people. It is rather disappointing to find no mention of Stallo's extremely important work in the theory of knowledge, especially when we see that the second chapter is headed "The Metaphysical Tendencies of Modern Physics," and read such passages as that on p. 70. But Prof. More's problem is not quite the same as Stallo's. In Stallo's time physicists vigorously denied that their theories had a metaphysical basis, and it was Stallo's purpose to show that the physicists were mistaken in their denial. But at the present time such a theory as Larmor's has an avowedly philosophical background. The great obligation of modern physics to Descartes is seen from the admirable discussion of Descartes' physical system in chapter iii. "A comparison of his [Descartes'] postulates and conclusions with those of our modern theory shows them to be almost identical, if we change his antiquated knowledge and his discarded metaphysical language into modern terminology" (p. 67; *cf.* pp. 98, 101).

The fourth chapter is a reprint of an article in the *Philosophical Magazine*, and, under the heading "The Scientific Method," contains a very sensible critical review of recent physical theory. Prof. More himself advances a hypothesis to make the ratio e/m agree with the experimental evidence (p. 140). The fifth chapter is on "The Classical and the New Mechanics," and here Prof. More concludes that, if we finally adopt the most modern thesis that matter is the manifestation of energy, we are acknowledging that "the guides to knowledge are now to be found in those subjective impressions which must depend on the individual, and vary with him. . . . The classical natural philosophy of Newton and Galileo has drifted into that transcendental symbolism which is apt to take place when German thinkers become the leaders in philosophy" (p. 163). The sixth chapter is on "Skepticism and Idolatry in Science," and here some of the writings of Poincaré and Sir Oliver Lodge make admirable illustrations; and the seventh chapter is on "Science as the Arbiter of Ethics." This is a thoughtful book, and though easy to read, is not superficial.

(2) Mr. Redgrove's book makes a great point of the fact that experience is subjective, as Berkeley pointed out, and of which Mach has made such illuminating use in physics. Of course materialism becomes easily refutable from this point of view. Mr. Redgrove leans to the mysticism of John Smith the "Cambridge Platonist," Boehme, and Swedenborg, but—and this would surprise some after that—he adopts what seems to be a very sensible attitude in his emphasis on the validity of the laws of nature, and the fallacy of "Christian Science" metaphysics. Mr. Redgrove follows Mill in thinking that mathematical truth is merely founded on experience, and holds that absolute truth is unknown and unknowable. In spite of this we may approach truth, "just as a mathematical series may for ever progress towards some limit which it never reaches" (p. 86). The mathematical illustrations seem to be quite irrelevant: we might just as well illustrate a fanciful doctrine that we can attain the limits of knowledge over and over again in our lives, and yet approach no definite knowledge, by instancing the function $\sin x$ as x proceeds to infinity along the real axis. ϕ.

RECENT ELECTRICAL BOOKS.

(1) *Arithmetic of Alternating Currents.* By E. H. Crapper. Pp. vii+208. (London: Whittaker and Co., 1915.) Price 2*s.* 6*d.* net.

(2) *Constant-voltage Transmission: a Discussion of the Use of Synchronous Motors for Eliminating Variation in Voltage in Electric Power Systems.* By H. B. Dwight. Pp. vii+115. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 5*s.* 6*d.* net.

(3) *Alternating-current Work: an Introductory Book for Engineers and Students.* By W. P. Maycock. Pp. xxiii+415. (London: Whittaker and Co., 1915.) Price 6*s.* net.

(4) *Experimental Electricity and Magnetism.* By M. Finn. Pp. x+436. (London: G. Bell and Sons, Ltd., 1915.) Price 4*s.* 6*d.*

(1) PROF. E. H. CRAPPER'S book can be recommended to all desiring to obtain a thorough working knowledge of the everyday calculations which have to be made by alternating-current engineers. The lengthy experience the author has had in training electrical engineers has convinced him that the only way to master the subject is to acquire facility in solving the types of numerical problems which occur in practice. There are 232 examples in the book. The answers to all of them are given, and fifty are worked out in full. They are arranged in order of difficulty, and none of them make excessive demands on the

knowledge or ability of the student. We have tested the numerical accuracy of the answers given to several of the problems with satisfactory results.

(2) Mr. H. B. Dwight is the electrical engineer to the Canadian Westinghouse Company, and is one of the greatest authorities on long-distance power transmission. To the reader conversant with the technicalities of electrical engineering this book can be warmly recommended. The author points out the advantages of using special synchronous motors to keep the voltages at the distributing stations constant under all conditions of load. By this means the radius of action of electric power transmission can be very considerably increased. The main advantage gained by this increase of distance is that it renders possible the linking together of large networks either directly or by suitable "frequency transformers." The economies rendered possible by this procedure are well known and much thought about by electrical engineers. Unfortunately the main difficulties in linking up all the supply companies in London have to do with the vested interests concerned and the inherent conservatism of station engineers.

In America there are several large networks already in existence. In North and South Carolina, for instance, over a thousand miles of 100,000-volt transmission lines are now linked together, the lines stretching across 800 miles of country. The Pacific Gas and Electric Company of California has a network of 1500 miles, part of it being at 60,000 and part at 100,000 volts. It is highly probable that even this extended supply of "electricity in bulk" will seem quite small in a few years' time, as some of the many schemes projected for linking up systems of electric railways are sure to be carried out. Mr. Dwight's book, therefore, discusses a problem of great commercial and economic value. In discussing the more technical side of the problem Mr. Dwight uses complex hyperbolic operators, and has been successful in considerably simplifying the usual treatment.

(3) Mr. W. Perren Maycock's book is intended as an introduction to alternating-current work. The diagrams are beautifully clear, the apparatus described is all useful and fundamental, and the descriptions are good. Simplified vector diagrams are given. Many will find this work useful as an introduction to more advanced treatises.

The defects of the book are due mainly to an attempt to explain to the non-mathematical reader certain steps in the proofs of physical theorems which demand mathematical knowledge. Unless these steps are proved rigorously it does not seem worth while to give them. No proof, for instance, is given that when the voltage follows the harmonic law its effective value equals 1·11 times its average value. To assume this, and to point out in reasoning backwards that

$$1{\cdot}11 = 0{\cdot}707/0{\cdot}636 = \pi/(2\sqrt{2}),$$

is rather a futile proceeding. It would be better to state definitely that the value 1·11 used by the designer of alternating-current apparatus is approximately equal to $\pi/(2\sqrt{2})$, which is the value deduced theoretically from the properties of the sine curve.

(4) From the point of view of the teacher, the chief merit of Mr. Finn's book is its thoroughly practical nature. Assuming that the physical laboratory is fitted with the electric light, he shows that many excellent and instructive experiments can easily be arranged for junior students. The student will appreciate the notes on heat and dynamics which are freely interpolated throughout the text. The introduction and explanation of technical terms in common use are innovations which are to be commended. Everyone should know what is meant by an adapter, a wall-plug, a kilowatt-hour, bayonet and screw cap lampholders, etc. We think also that all teachers should know what is meant by "earthing," and that one of the mains of the supply company is usually earthed. Electrical students have generally very hazy notions about what is meant by the potentials of the supply mains. They seem to have acquired at school the notion that difference of potential is the only thing that need be considered, and that the absolute value of the potential is of no consequence. A good teacher could easily explain the fallacy of this by pointing out how workmen sometimes get dangerous shocks owing to neglect of certain very elementary precautions.

In one or two places the author's experiments are perhaps too elementary. For example, it seems unnecessary to prove that the currents in conductors in parallel are not always equal to one another. In some places the wording is clumsy. On p. 374, for instance, instead of saying "the bigger is the dielectric strength said to be," it would be better to say "the greater the electric strength." We are told that the "dielectric constant" of a medium "varies somewhat with the length of time for which the E.M.F. is applied." Whether this is true or not depends on how we define the dielectric constant. It certainly varies with temperature. Everyone must perforce admit that it is not a constant. It seems foolish, therefore, for physicists to go on calling it a constant. The terms inductivity, dielectric coefficient, and S.I.C. are in use. There is no excuse therefore, for using the word "constant" for a variable quantity.

After defining the electrostatic unit of potential,

the author goes on to say that "it follows" that the electrostatic unit $= 3 \times 10^{10}$ A.E.M.U.'s of E.M.F. = 300 volts. It would be a phenomenal beginner who was able to follow this reasoning without further explanation. A. RUSSELL.

OUR BOOKSHELF.

Overcrowding and Defective Housing in the Rural Districts. By Dr. H. B. Bashore. Pp. 92. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 4*s.* 6*d.* net.

WE are apt to associate overcrowding and defective housing with towns in the "old" countries, but it is well to realise that a condition of things as bad or worse may exist in our rural districts and in new settlements. In this little book Dr. Harvey Bashore, an inspector in the Pennsylvania Department of Health, describes conditions of overcrowding and defective housing which exist in his own district. He deals with the subject under four headings: (1) land overcrowding; (2) house overcrowding; (3) defective buildings; and (4) overcrowded and defective schools.

Instances of these various conditions, illustrated by well-reproduced plates, are given, and the results are summarised in a concluding chapter. The latter are exactly the same as in the great cities—lack of efficiency, disease, and premature disease to many—"while the great majority of people subjected to overcrowding and bad housing do not prematurely die, yet they have a lessened physical and mental vigour and are less able to do properly their daily work, and not only become a loss to themselves and their families, but to the State; and for ever stand on the threshold of that dread disease—tuberculosis; for tuberculosis is the one great disease of the overcrowded." As regards the remedy, Dr. Bashore says: "This problem cannot be attacked, as in the great cities, by legislative enactment or resort to legal measures, but the solution lies in proper education by the health authorities, by the schools, and by the Press, and the crusade must be kept up until the people understand that it pays—pays in real dollars and cents—to live in sanitary homes."

Although written from the American view-point, we would commend this little book to the notice of councillors, landlords, and health visitors in this country. R. T. HEWLETT.

Typical Flies. A Photographic Atlas of Diptera, including Aphaniptera. By E. K. Pearce. Pp. xii + 47. (Cambridge: At the University Press, 1915.) Price 5*s.* net.

THIS volume contains four pages of introduction, with instructions for collecting and for setting specimens of flies caught, Brauer's Classification of Diptera (four pages), and 155 reproductions in half-tone of photographs of fleas and flies. Its aim is to be of service to the beginner and to draw attention to the interest of an order of insect that is much neglected.

The photographs are as good as any we have seen of this class of insect—a peculiarly difficult class to represent pictorially in any natural manner; the venation of the wings is well brought out wherever the banding or colouring of the wings does not obscure it, and there are excellent short notes as to habitat, larval habits, and so on under the pictures. We wish it had been possible to provide under the photographs line drawings of the more important types of venation and of some of the antennæ; but the interest taken in this group is so little that we imagine further expenditure on the volume was impossible.

The diversity of appearance is well brought out; to the student the venation systems depicted will be helpful, and to the beginner the variety of habitat and habit will be distinctly stimulating.

Probably no order of insect will so well repay the collector and investigator in this country, and we hope this volume may stimulate a wider interest in this fascinating group. H. M.-L.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Destruction of Wasps.

YOU may be interested to know that whilst starting up a motor-cycle a few days since, I accidentally discovered that benzol sprayed over a wasp instantly killed it. I tried the same experiment with petrol with the same result.

Knowing of two nests in the neighbourhood I went that night and with a small oil gun injected two or three ounces of benzol into each nest. In the morning I found the two nests entirely destroyed.

Next night I visited an open nest which had been partly destroyed by another means, and in which several hundred wasps were still living. They covered an area as large as a cheese plate, and on lighting them up showed signs of activity. One squirt full of petrol was hastily sprayed over them, and the whole lot were instantly killed.

This method is so safe, simple, and effective that I feel it should be generally known. The petrol or benzol acts entirely by vaporisation and produces asphyxiation. It is not fired in any way.

A. H. MITCHELL.

Horn's Green, Knockholt, Kent, August 24.

Atlantic Oceanic Currents.

A LARGE bell-buoy was cast ashore at Porto Santo, the northern island of the Madeira group, in the early days of March in the present year.

I have ascertained that the buoy came from Pearl Reef, Magdalen Islands, in the Gulf of St. Lawrence, having broken adrift from its moorings in the autumn of 1912, occupying thus two years and a half in transit. These facts are important at a time when our accepted notions of the strength and direction of the Atlantic currents are undergoing revision.

It may be remembered that Christopher Columbus, who resided at Porto Santo, and married a daughter of Peristrello, the Governor in those days, derived his inspiration and dream of lands beyond the sunset from the arrival of seed-pods and other suggestive matter drifting in upon the broad current which bathes these rocky shores. MICHAEL C. GRABHAM.

Madeira, August 19.

THE BRITISH ASSOCIATION MEETING IN MANCHESTER.

THE meeting of the British Association in Manchester will provide a busy week for those who choose to avail themselves of the opportunities provided for scientific discussion and visits to places of special interest. As previously announced, the long-distance excursions that old members are accustomed to on the afternoon of the Saturday and on the last Wednesday of the meeting will not be found on the programme, but the executive committee has arranged for a large number of visits to the principal municipal undertakings, works, and warehouses, which should prove to be of exceptional interest. Most of these visits will be made in the afternoon, and will not therefore interfere with the important work of the sections. It is difficult to select from the list any one that may be regarded as especially noteworthy because there is so much variety offered by the great industrial community of which Manchester is the centre, and an appeal to many different interests will be made. But as the Manchester Ship Canal is sometimes regarded as one of the wonders of the world, it is probable that the visit to the Manchester docks and canal will be one of the most attractive features. This visit will take place on the afternoon of Friday, September 10, and the party will be limited to one hundred. The Ship Canal Company has kindly provided a special steamer for the visitors, and arrangements will be made for the inspection of all the principal engineering features of this great undertaking.

The important works of the Manchester and of the Salford electricity departments will be shown to small parties in the course of the three working days of the meeting, and opportunities will be afforded for members and associates to visit the corporation gas works, water works, and sewage disposal works. Of the visits to the works of the principal Manchester industries that to the Pilkington Tile and Pottery Co. at Clifton Junction will probably be one of the most interesting; but the most ambitious so far as distance is concerned is the proposed visit to the soap works of Messrs. Lever Bros. at Port Sunlight on Thursday, September 9.

Other visits that may be specially referred to are to the works of the cotton spinners, of several large electrical machinery manufacturing companies, of the great Manchester warehouses, of the hat manufacturers of Stockport, of the calico-printers, of the packing warehouses, etc.

In connection with the special work of the sections several excursions on a small scale have been arranged. Thus, Section C (Geology) will adjourn in the afternoons for visits to places of geological interest in the immediate neighbourhood for field demonstrations of Dr. Hickling's paper on the geology of Manchester, and there will be a longer excursion arranged for the Saturday afternoon. Section D (Zoology) will adjourn to the zoological laboratories on Thursday afternoon for exhibits and demonstrations of original work that has been conducted or is in progress in the university. Section E (Geography) proposes an afternoon excursion into Derbyshire. Section H (Anthropology) proposes a visit to the Roman camp at Ribchester, on which occasion Sir F. F. Adam will preside. For Section K (Botany) a series of interesting demonstrations in the botanical laboratories of the university are being arranged; and Section L (Educational Science) has arranged for two visits to educational institutions, one, on Thursday afternoon, to the Kindergarten Training College in Whalley Range, when Sir William Mather will entertain the party to tea, and the other to the school for feeble-minded children at Sandlebridge.

On Wednesday evening the Lord Mayor of Manchester will hold a reception in the Manchester School of Technology from 8 to 8.30, after which members and associates will be able to inspect the workrooms, machinery, and appliances of the institution.

Every effort is being made by the local executive committee to ensure the success of the meeting, and although it cannot be expected that the numbers will be as large as they would have been in normal times, there is every prospect of a good attendance of men of science and of important work being done.

ART AND CRAFT IN FISHING.[1]

IN recent years the contemplative man seems to have changed his nature, to judge from some of the books which he gives to the world. Time was when he was content just to go fishing, with the simple object of catching fish. But now his demeanour is more that of a man who is setting out on a serious piece of scientific work, and, though he has not quite lost what Francis Francis used to call "a kind of prejudice for a brace of fish in the creel," he is mighty particular as to how that brace of fish got there. Should he, so to say, have been overtaken in inadvertency and have decoyed one of them in a manner not permitted to the elect, his conscience will know many pangs, and likely his tongue will begin the story with apology and end with explanation. There is no longer pride in a fish just as a fish. The modern achievement is a fish caught on a female olive. The same fish caught on an Alexandra would be like a shot fox; for the angler has become a much improved and superior person, and (may we confess it?) at times a little difficult to live with.

His literature, however, has certainly gained in interest, because it can no longer be said, as it used to be said, that there is nothing new to be written about fishing. The mere discovery of the female olive brought a whole new world swimming into one's ken. And since then there have been

[1] (1) "Fly-Fishing: Some New Arts and Mysteries." By J. C. Mottram. Pp. xii+272. (London: *Field* and *Queen* (Horace Cox), Ltd., n.d.) Price 5s. net.

(2) "The Complete Science of Fly Fishing and Spinning." By Fred. G. Shaw. Pp. xiii+432. (Published by the Author, Neville Court, Abbey Road, N.W., 1914.) Price 21s.

other developments to give the angler a still more earnest countenance, such as the discovery that a fish's life-history is written on its scales, or that you may capture a chalk-stream trout with a wet fly, not as of old empirically, but with due regard to all the laws of science, and in a manner to command the admiration of the impartial.

(1) Dr. Mottram's little book is an excellent sample of the newer fishing writing, in which various old problems are approached in the spirit of scientific inquiry, solutions being offered in a way that inspires confidence. The author is evidently a good and very zealous angler, he has had a scientific training, and he does both experiment-

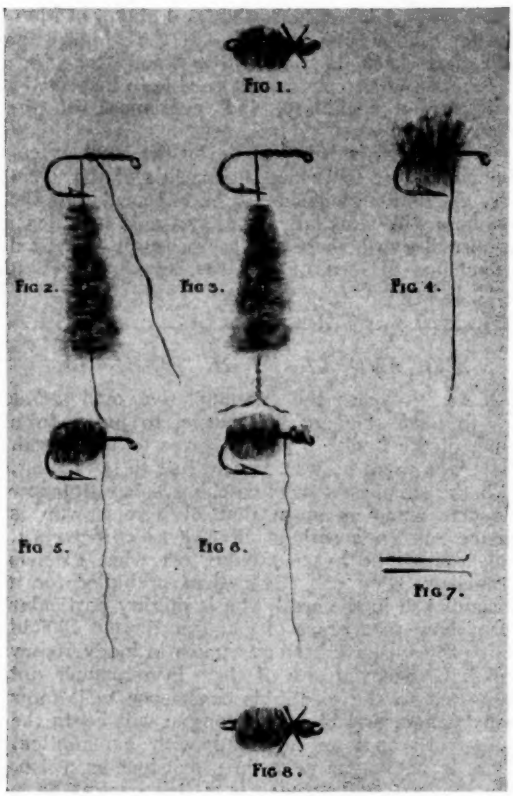

FIG. 1.—The tying of a new fancy fly. From "Fly-Fishing: Some New Arts and Mysteries," by J. C. Mottram.

ing and thinking for himself. He seems singularly free from the common angling tendency to take other people's experience for ascertained fact, which gives his conclusions, even in matters on which others have written with authority, a value of their own. He treats of a great diversity of subjects, of water weeds and their merits as food-producers (here, though generally sound and useful, he is too sweeping; for instance, he condemns *Elodra canadensis* out of hand, which seems strange; it is horribly free in its growth, but it is far from being a bad weed otherwise); of the colour sense of fish, citing a very interesting and careful experiment, which showed a roach to have a sense of colour; of optical problems, which are about the latest of the fly-fisher's studies, adding something to our ideas; of waterside fly-tying, the treatment of mud, fish watching, difficult casts, and so on. He gives several chapters on his own sport, especially in New Zealand, where he seems to have been about the first angler to study natural flies and imitate them.

This brings us to what is certainly the most important part of Dr. Mottram's book, his theory of imitation of flies, which is unfolded in a chapter entitled "Flies of the Future." He breaks boldly away from the exact imitation school with its tradition of stiff opaque wings for floating duns, and substitutes what might be called a policy of impressionism, in which he lays special stress on the shape of a fly's body and on methods of obtaining the transparent effect which is so defiant of imitation in the natural dun. The idea that "one of the best ways of indicating transparency is to omit the transparent parts altogether," is extremely ingenious, and it should work out well in practice. Ingenuity is, indeed, a marked feature of the whole book, which is a valuable addition to the fishing library.

(2) Mr. Shaw's book is a more ambitious volume, as its rather formidable title would indicate. The "complete science"—it is a big aim. In one respect, however, Mr. Shaw seems to us to justify his selection of the title. There is probably no angler of the day who has so carefully studied what may be called the dynamics of fishing, the various ways of getting a fly or spinning bait to a given point in the most effective manner. Mr. Shaw's chapters on casting show a remarkable grasp of principles, the exposition of which will teach even the oldest hands a lot. Most anglers—even very good—cast their fly or bait without any very clear notion how they get the results they aim at. They know these to be fairly satisfactory and do not trouble further. Mr. Shaw shows exactly what happens when you do certain things with your rod, and proves conclusively why it must happen. Also he suggests many other things which you may do, things of which you have very likely never thought, and which are bound to be extremely useful to you. Wind casts, Wye casts, steeple casts, Galway casts, loop, switch, and Spey casts—there are many devices by which you can get the better of difficulties. With excellent photographs and diagrams Mr. Shaw expounds them all, and if it is possible for a man to learn technique from the printed page—and it certainly is possible for some—he should gain a great deal from this book.

In the other portion of the volume he deals partly with the practice of fishing and partly with various matters, more or less scientific, in which the angler takes an interest. He is obviously a good fisherman as well as a good caster (the two are not necessarily complements of each other), and he is full of useful hints and contrivances such as an expert picks up in many years of fishing.

For instance: "Use the two tops of your fly-rod alternately," he advises, and the advice is very obviously sound. But some of us, alas! have never thought of it before, regarding the second top as merely a spare one for emergencies. And yet we have talked to each other with conviction about split cane getting "tired" after continuous use for some time! This is a small matter, but there are plenty of similar casual hints which will come forcibly home to a good many of us who have long passed out of our novitiate.

In the other chapters Mr. Shaw deals with the fisherman's entomology, now a fairly well-ploughed field, with pisciculture and the natural history of trout, of which much the same may be said, now that there is a trout farm in almost every likely valley of springs, with the senses of trout, particular attention being paid to their vision, and especially to how far they can see behind them, a point which so far as we remember

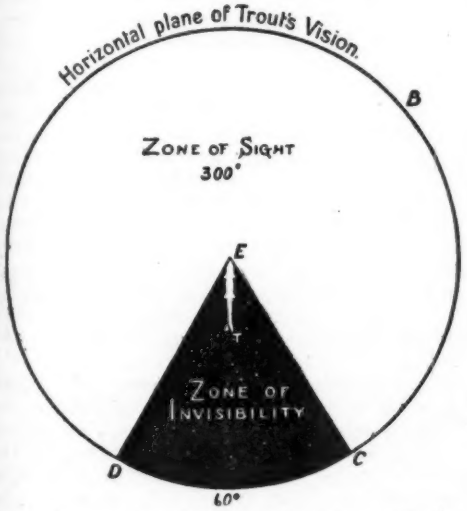

FIG. 2.—From "The Complete Science of Fly Fishing and Spinning," by F. G. Shaw.

no other writer has tackled—but it is one of importance, as every man who has stalked a fish on a "shy" day will allow.

There are also chapters on salmon and salmon scales. In the last Mr. Shaw devotes a great many words to labouring what seems to us an odd objection to the usual interpretation of what is called the spawning mark, which is, of course, that a fish has spawned in some previous year. Mr. Shaw apparently wants evidence of the act itself before he will admit that salmon ever spawn more than once. The spawning mark, in his view, would, we gather, be evidence of a visit to fresh water for the purpose of spawning, but not necessarily that the purpose was satisfactorily accomplished, the ova being duly fertilised and safely stored in the redds. So far nobody would quarrel with him, we expect, but, unless we wrong him, he seems to find in the spawning mark evidence that the spawning purpose has *not* been carried out, the eggs being voided in vain or re-absorbed. A fish so cheated "will return again and again until it has satisfactorily achieved its life's purpose." We fear we cannot produce scales from a fish marked in the act of spawning and recaptured later, to convince Mr. Shaw. Perhaps he can produce scales from the necessary percentage of unfortunate fish which have been found voiding their ova in vain to convince us? At present our inclination is towards the current view of the spawning mark and its significance. There are other points in the book in which our view would not coincide with Mr. Shaw's (incidentally we have found some scarcely excusable misprints), but on the whole we must own to having studied him not without pleasure and profit.

THE TESTING OF CHRONOMETERS.[1]

IN his recently issued report on the testing of chronometers at Geneva, M. Raoul Gautier, who has been in charge of the department for twenty-five years, takes the opportunity of reviewing briefly the successive alterations and improvements that have been introduced in the methods of testing, and the happy results that have followed from the maintenance of a high standard. We may take this same opportunity of congratulating the distinguished director of the observatory on the useful work accomplished, and with which the name of Gautier has been so long and so honourably connected.

Nearly a century has passed since Alfred Gautier combined the duties of the director of the observatory with those attached to the Chair of Astronomy. But even before that time Geneva was bidding for the watch trade and fully alive to the advantage that would accrue from an increase in the accuracy of performance. In 1789 prizes were offered by the local Society of Arts for a notable improvement in the rate of pocket watches, but the prize remained unawarded, for the ambitions of the judges were so much in advance of the abilities of the maker that the standard was not attained. In framing more modest requirements, it was stipulated that the daily rate of the watch should not vary more than one minute during a trial of a month in a vertical and horizontal position, and not more than two minutes when worn for the same period. Two watches were submitted, and one was stated to have fulfilled the conditions.

These were humble beginnings, and the disturbed state of Europe during the Napoleonic wars prevented anything like an annual competition, which the local Society of Arts proposed to hold. But progress must have been rapid, for in 1816 the limit of variation of rate was reduced to three seconds in twenty-four hours, whether the watch was at rest or carried in the pocket. For the first time we find a temperature factor mentioned: the watch was to be kept in a constant temperature of 25° Réaumur, and it was not till much later that any serious attempt was made to remove the ill

[1] "Rapport sur le Concours de Réglage de Chronomètres." Par M. le Prof. Raoul Gautier, Directeur de l'Observatoire de Genève.

effects of varying temperature on the rate of pocket watches.

The main fact to be noticed in connection with these early trials is that they settled the lines on which future tests have been made. The qualities demanded now are, as they were then, smallness of daily rate, uniformity of rate in different positions of the balance, and constant rate within a considerable range of temperature. The number of variables is small, and wherever chronometer testing is carried on, little change has been made in the manner of conducting the test. Details vary at different observatories, but one general practice is pursued. For a certain number of days constituting "a period," the watch is kept in a vertical position with pendent up, or to the right, or left, and horizontally, with dial up or down. Further the watch is submitted to varying temperature, generally covering about 50° F. in the whole, and throughout the several "periods" the daily rate is determined by comparison with a clock regulated to Greenwich Mean Time. The relative excellence of the instrument tested in shown by assigning marks for its performance in each period, and herein there is room for the exercise of individual judgment in deciding relative merit. One authority may consider the elimination of temperature effects of more importance than smallness of rate, and give higher marks accordingly. To secure accurate adjustment for "positions" may seem to some the most desirable qualification.

M. Gautier hints that steps might be taken with advantage to secure greater uniformity among different observatories. But the system of awarding marks is of no great importance, for a good watch comes so near perfection that it will take nearly the maximum of marks, however they are divided. M. Gautier remarks that a comparison between the trials at Kew and Geneva shows that the results are in close agreement, and that this conclusion is warranted is proved by the fact that the best watch at Geneva, tested by the Kew system of marks, would have 95·9, while the best at Kew was assigned 96·1 marks.

At Geneva, to within the last few years, the total number of marks that could be earned was 300, of which 100 were assigned to steadiness of daily rate (m); 100 to uniformity of rate in different positions (p); 70 for excellence of temperature compensation (c); and 30 for smallness of variation (r) throughout the test. At the same time limiting values are assigned to m, p, c, and r, which may not be exceeded without loss of certificate. These several maximum values are shown in the expression from which is computed the number of marks to which the watch is entitled.

$$N=(0''{\cdot}75-m)\,400/3+(2''{\cdot}50-p)\,40+(0''{\cdot}20-c)\,350+(5''{\cdot}00-r)6.$$

If any one of these terms is negative the watch fails to meet the test, but it can be withdrawn, corrected by the maker, and re-submitted to test in those particulars in which it failed, but the opportunity of competing for the highest places in competitive tests is denied to such watches. Later, the number of marks was increased to 1000, but the two scales are not directly comparable, for the conditions of test have been made more severe. The variation from daily rate must not exceed 0·5 sec. in any one test, the rate in different positions is reduced from 2·5 sec. to 2·0 sec., and in other respects the demand for greater accuracy is on the same scale.

It is gratifying to know that the improvement in manufacture has more than kept pace with the requirements for test, and that M. Gautier is able to report that the highest excellence yet attained was exhibited by the chronometers of 1914. This also is the experience of Kew, where of sixty-two watches submitted to trial, forty-eight were awarded more than 90 per cent. of the maximum marks. Of even greater significance is the increasing certainty of manufacture. The writer of this article has long held that after a certain high standard has been reached, the maker must depend upon some lucky accident for pre-eminence. He is unable to explain the cause of superiority, and though he may take equal care he cannot repeat his success. But when we find that the Kew record is held by M. P. Ditisheim, of Chaux-de-Fonds, with a score of 96·1, and the same maker is able to secure the first four places in a competition of unusual severity, it is evident that chance is fast being eliminated. Such improved workmanship demonstrates the success that has attended the scheme of annual competition, originated with the view of encouraging the Swiss watch manufacture. The number of watches submitted for test is not large, about 200 per annum, but a healthy competition has raised a high standard of excellence, and taught the public what to expect.

Besançon leads the way in France. The method of test varies slightly from that of Geneva, but the details only concern the expert. The point we would make is that such establishments are eminently useful and instructive. By advertising widely what has been accomplished they make the public dissatisfied with inferior workmanship, and they offer opportunities for the careful maker to gain recognition for his work. A standard of accuracy is set up that encourages the public distribution of time signals, and promotes a smoother working of national life.

FREDERICK MANSON BAILEY, C.M.G.

THE death of Frederick Manson Bailey, C.M.G., the veteran Colonial Botanist of Queensland, which was announced in the last issue of NATURE, will be felt as a great loss to Australian botany. He inherited his botanical tastes from his father, John Bailey, who emigrated to South Australia in 1838, the family having conducted the business of nurserymen and seedsmen in London for many years. F. M. Bailey helped his father for a time in the nursery business at Adelaide, which he established on resigning the position of Government botanist—to which post he was appointed on his arrival in South Aus-

tralia—but he did not seriously take up horticulture again until he landed at Brisbane in 1861 after a spell of gold-digging in Victoria and farming in New Zealand. He then established a seed business in Brisbane, a venture, however, attended with no great measure of success owing to financial conditions in Queensland, but his real opportunity came in 1875, when the Queensland Government appointed a committee to inquire into diseases affecting live stock and plants, and he was chosen to investigate the botanical problems involved. In connection with the duties of this appointment he travelled far and wide throughout the State, and gained that extensive knowledge of the flora of Queensland which enabled him to make his numerous and valuable contributions to Queensland botany.

His earlier work was mainly connected with the native grasses of Queensland, which formed the subject of many articles valuable to the botanist and agriculturist alike. He was next appointed to the charge of the botanical section of the Queensland Museum, and in 1881 was made Colonial Botanist, the post which he held until his death. The duties of this post, which were very congenial to him, he discharged with conspicuous ability and untiring devotion, and, during the times of depression when the post was abolished, he continued his work unpaid until, as a result of general protest, he was reinstated in his former position.

The distinction of C.M.G. conferred upon him in 1911 was a fitting recognition of the value of his botanical and agricultural services to Queensland. His contributions to botany embrace the purely systematic as well as the economic aspects of the subject. Another subject to which he paid particular attention was the medicinal uses of plants.

Among his more important publications must be mentioned "The Flora of Queensland" in seven volumes; "The Handbook of the Ferns of Queensland"; a sketch of the "Economic Plants of Queensland"; "Plants reputed Poisonous and Injurious to Stock"; "Queensland Woods"; "Queensland Grasses," etc.

Bailey also devoted much time and attention, especially in later years, to the study of fungi and algæ, and until a few days before his death he was a regular contributor of critical specimens to the National Herbarium at Kew, which has been greatly enriched, as regards the Queensland flora, by the specimens he so generously presented.

NOTES.

WE see from the Transactions of the Royal Scottish Arboricultural Society (of which he is the honorary editor) that Dr. A. W. Borthwick, lecturer in forest botany in the University of Edinburgh, has been appointed by the Board of Agriculture for Scotland to be the advisory officer of the Board for forestry in succession to the late Dr. John Nisbet.

WE learn that the nineteenth International Congress of Americanists, which was to have been held in Washington in October next, and which was postponed in consequence of the war, is, according to present arrangements, to take place at Washington on December 27–31 next, in conjunction with the anthropological section of the Pan-American Scientific Congress, the American Anthropological Association, the American Historical Association, the American Folk-lore Society, and the Archæological Institute of America.

THE autumn meeting of the Iron and Steel Institute will be held at the Institution of Civil Engineers on September 23 and 24, when the following papers may be expected to be read and discussed:—Influence of oxygen on some properties of pure iron, W. Austin; note on the carburisation of iron at low temperatures in blast-furnace gases, T. H. Byrom; influence of heat-treatment on the specific resistance and chemical constitution of carbon steels, Prof. E. D. Campbell; effect of chromium and tungsten upon the hardening and tempering of high-speed tool-steel, Prof. C. A. Edwards and H. Kikkawa; phosphorus in iron and steel, Dr. W. H. Hatfield; the magnetic transformation of cementite, Prof. K. Honda and H. Takagi; sulphur in malleable cast-iron, R. H. Smith; iron and nitrogen, Prof. N. Tschischewski.

THE council of the Iron and Steel Institute gives notice that at the forthcoming meeting of the institute the following new rule for addition to the existing by-laws will be submitted:—"In the event of a state of war existing between Great Britain and any other country, or State, all members, honorary members, and honorary vice-presidents who shall be subjects of such enemy country, or State, shall forthwith cease to be members, honorary members, or honorary vice-presidents of the institute, but they may, if the council thinks fit, be reinstated after the termination of the war."

THE Royal Aero Club announces that the British height record for pilot alone has been granted to Mr. H. G. Hawker, the National Physical Laboratory having reported that the barograph and chart used by the aviator on June 6 showed that the height attained was 18,393 ft. The previous best record was that of 14,920 ft., accomplished by Eng.-Lieut. E. F. Briggs, now a prisoner in Germany.

WE deeply regret to record the death in action at the Dardanelles, on August 10, of Second Lieut. H. G. J. Moseley, Trinity College, Oxford, son of the late Prof. H. N. Moseley. Lieut. Moseley was formerly lecturer and demonstrator in physics at the University of Manchester, and holder of the John Harling fellowship for research.

WE much regret to learn that Capt. T. P. Black, 9th Sherwood Foresters, registrar of University College, Nottingham, was killed at the Dardanelles between August 7 and 11. He was for a time assistant in physics at the Durham College of Science, Newcastle-upon-Tyne, removing in 1907 to University College, Nottingham, to fill a similar position. In 1911 he was appointed registrar of the college.

WE note, with regret, the death, on August 28, at the age of fifty-six years, of Mr. Henry Crookes, the eldest son of Sir William Crookes. He was an asso-

ciate of the Royal School of Mines, and a fellow of the Chemical Society.

THE death is announced of Lieut.-Col. Edward Lawrie, M.B., I.M.S. (ret.), at the age of sixty-nine. Col. Lawrie was educated at Edinburgh University, and after acting as house surgeon to Prof. Syme, whose views probably largely influenced his subsequent work on chloroform anæsthesia, he entered the Indian Medical Service, from which he retired in 1901. During his career he held the posts of resident surgeon of the Medical College Hospital, Calcutta, acting for some time as professor of physiology in the Medical College, professor of surgery in the Lahore Medical College, and residency surgeon at Hyderabad, one of the most important medical appointments in India. He was best known for his views on anæsthesia, being an ardent advocate of the claims of cholorform to be the best and safest anæsthetic for general use. Lawrie held, with his old teacher Syme, that chloroform killed only through the respiration, and not through the heart. As many held the converse opinion, Lawrie prevailed upon the Nizam of Hyderabad to institute and finance a commission to investigate the subject, of which commission Sir Lauder Brunton was president and Col. Lawrie and the late Sir Gerald Bomford were members. Much experimental work was done, which confirmed Lawrie's views, the monkeys dying without exception from failure of respiration, and a valuable report was published; he was also the author of "Chloroform: A Manual for Students and Practitioners" (1901). When the hospitals for the Indian troops were opened at Brighton in December last, Lawrie was appointed anæsthetist, and carried out his duties until the beginning of his fatal illness last May.

LIEUT. ERNEST MAGOWAN HARPER, 7th Batt. Munster Fusiliers, who was killed in action on August 9, at the Dardanelles, was a graduate of Queen's University, Belfast. He was educated at the Royal School, Dungannon, where he gained a reputation for brilliant work, and received his training as a keen sportsman, which afterwards characterised him at the University. On matriculation he entered Queen's with a junior science scholarship, which he held throughout his undergraduate course. In 1913 he graduated bachelor of science with first-class honours in chemistry, and afterwards was appointed to the Andrews research studentship, which he held until the time of his death. During his tenure of this scholarship he conducted extended researches on the connection between the absorption spectra and the constitution of organic nitro-compounds, publishing two papers in the Journal of the Chemical Society. On the declaration of war he applied for a commission and was gazetted last September, being posted to the 7th Munster Fusiliers. He relinquished his post of senior assistant in chemistry in the University, abandoned his scientific career, and gave himself up unselfishly for his country's cause. In his death the country has lost an able officer, and science a most promising young man.

LIEUT. WOLFRED REEVE CLOUTMAN, R.E., who was killed in action in France on August 21, was an associate of the Royal School of Mines, obtaining his associateship in mining (first class) in 1912, after winning many prizes and completing a most distinguished career at the school, where his death is felt as a serious loss. Mr. Cloutman's work at the Royal School of Mines (an integral part of the Imperial College of Science and Technology) was further recognised by the award to him of the diploma of membership of the Imperial College. On leaving the school Mr. Cloutman was awarded a scholarship by the council of the Institution of Mining and Metallurgy for a post-graduate course in mines or works in various parts of the world. In 1914 the governors of the Imperial College awarded to him the Warrington Smyth prize and medal for a report which he submitted on certain mining operations in Western Australia. As a mining engineer Mr. Cloutman was valuable to the Army, and in June last he was mentioned in despatches for his skill and success in mining operations.

THE death is announced, at the age of forty-nine years, of Dr. R. W. Johnstone, a medical inspector of the Local Government Board. Dr. Johnstone had been British delegate at the International Health Office, Paris, a member of the Commission for the Investigation of Mediterranean Fever, chief technical delegate for Great Britain at the International Sanitary Conference at Paris, 1911–12, and plenipotentiary to sign the International Sanitary Convention of Paris in 1912.

THE death is reported, in his sixty-fourth year, of Dr. Thomas Bliss Stillman, an American chemist, who had spent the greater part of his career on the staff of the Stevens Institute of Technology, New Jersey. From 1886 to 1903 he was professor of analytical chemistry in that institution, and from 1903 to 1909 professor of engineering chemistry. He was the author of "Engineering Chemistry," first published in 1897, and of various monographs in American and European scientific journals.

MANY of our readers, especially among those who attended the meeting of the British Association at Winnipeg in 1909, will be grieved to hear of the death of Mrs. W. H. Thompson, who has recently succumbed to an attack of appendicitis. Mrs. Thompson was an active member of the committee responsible for the arrangements of the Winnipeg meeting. She was for some years a contributor to the work of the Ductless Glands Committee, and published an important paper on the thyroid gland (Phil. Trans., 1910), in addition to contributions to the Trans. of the Royal Society of Canada and other journals. For some years Mrs. Thompson was librarian of the University of Manitoba, and her loss will be keenly felt in academic circles in Canada.

MR. BERNARD KETTLE, curator of the Guildhall Museum, reports some interesting finds of Roman pottery from dust-heaps in the City of London. A large series of these was disclosed when the old General Post Office in St. Martin's-le-Grand was demolished. A few whole pots and many fragments of Samian ware were found here, besides building

materials, whetstones, beads, knives, coins, and other small objects. Most of these rubbish-pits date between A.D. 50 and 200, and by comparison of datable with undatable specimens much light has been thrown upon the seriation of types. From another rubbish-pit in King William Street nine Samian vessels of the first century have been reconstructed, one of them being a vessel finer than any hitherto found in London, and two specimens of a type hitherto unknown in England. These were associated with a lamp, two coins, and other pottery and bronze objects.

THE novel discovery in the Fayum of a nephrite celt is announced by Mr. Oric Bates in the September issue of *Man*. This specimen is remarkable because its greatest width is not, as in the common Fayum type, along the cord of the cutting edge. The material is a sort of nephrite, composed of minute fibres of actinolite, and in its present form it is of metamorphic origin. The source whence the stone may have been obtained is at present uncertain, and it is impossible to say whether this development of actinolite is due to regional metamorphism or contact metamorphism. At any rate, the rock can only have come from some region where there has been extensive metamorphism of one kind or another.

AN important monograph on the genus Sansevieria, the source of bow-string hemp, occupies seventy-six pages of the current number of the *Kew Bulletin* (No. 5). The account is by Mr. N. E. Brown, who has made a lifelong study of this difficult and highly important economic group of plants. The paper is illustrated by a series of text figures representing the salient features of the different species, and there are two plates of a new species, *S. Dawei*, from Uganda. Fifty-four species in all are described in detail, and a full key is provided which should be of great value in running down the plants. In order that the paper may be of use to the planting community, in whose interests it has largely been prepared, the few technical terms employed are fully explained at the beginning. Africa is the true home of the genus, and East Africa in particular, where it is an important economic product. Only four species are known to occur outside Africa, and they are found in Ceylon, India, Burma, and possibly China. Of the fifty African species only five are natives of South Africa, the rest being confined to the tropical area of the Continent. As considerable doubt still exists as to which species yields the best fibre, it is hoped that the publication of the monograph may help to bring about a solution of so important a question.

BOTANICAL specimens are commonly deprived of all beauty, and much of their value, by the loss of colour in the flower-heads. This very serious drawback has now been removed by the timely discovery of a method of colour-preservation by Dr. C. F. Fothergill, and described in detail in the *Museums Journal* for July. It has the further merit of extreme simplicity. Briefly, Dr. Fothergill employs sheets of absorbent cotton wool, placed in three layers forming two compartments between two "grids," which are made of a "wire mesh-work of half-inch squares with a heavy encircling band." The necessary pressure is obtained by fastening one or two straps, preferably of webbing, around the grids, and tightening them as required. The flowers to be pressed, having been placed in the grid, are then suspended in front of a fire, or in the sun, when this is sufficiently powerful. The explanation of the success of the method is, that the process of drying is so rapid that the pigment is fixed instead of being slowly decomposed. Fresh carnations can be preserved in about seven hours. Primroses picked fresh off the living plant can be permanently dried to retain a lifelike colour in two hours if the press containing them is placed in the oven.

THE first part of vol. v., section 2, of *Flora Capensis* has now appeared, having been prepared at the Herbarium of the Royal Botanic Gardens, Kew. The families dealt with are the Thymeleaceæ, 181 species in twelve genera; the Peneaceæ, 24 species in five genera; the Geissolomaceæ, with the single monotypic genus Geissoloma; the Loranthaceæ, consisting of 42 species in two genera; and the Santalaceæ. This last family, which contains six genera in South Africa, is completed as far as the 112th species of Thesium in the present part.

PROF. G. S. BOULGER has published in the form of a pamphlet, price one penny, his paper on the History of Kew Gardens, read before the South-Eastern Union of Scientific Societies. The paper, though covering a well-explored field, contains several interesting particulars about the early history of the Royal Gardens. A letter from Gilbert White to Robert Marsham about Stephen Hales, written in 1791, which is reproduced, presents a very vivid picture of that ingenious physiologist's versatility in all forms of experiment. The history is brought down to the present day, and an outline of the functions of Kew is given in conclusion.

AT the last monthly general meeting of the session of the Zoological Society of London, his Grace the Duke of Bedford in the chair, it was announced that two Californian sea-lions had been added to the menagerie of the society, thus partially repairing the loss by disease sustained some time ago. Two tortoises, new to the collection, were received on deposit on July 18. One of these is the blackish tortoise (*Testudo nigrita*) from Indefatigable Island, the other Bauer's tortoise (*T. galapagoensis*) from Charles Island. The receipts in gate-money for July showed a decrease of 72*l*. as compared with July of last year. The receipts for admission at the gates during the present year—to the end of July—showed a decrease of 27*l*. as compared with the corresponding period during the last ten years. Having regard to the times, this falling-off in receipts is less than might have been expected.

THE *National Geographic Magazine* for August should attain a phenomenal sale, if only on account of its illustrations, which include no fewer than eighty coloured figures of American game birds, by Louis Fuertes. Both from the point of view of scientific accuracy and artistic merit these are as near perfec-

tion as is humanly possible. These illustrations accompany an article on American game birds, by Mr. Henry Henshaw, which should be seriously studied by every field naturalist and sportsman in the British Islands; for the author draws a by no means exaggerated picture of the ravages inflicted by modern firearms on birds of real economic importance, and the need for drastic legislation to prevent their speedy extermination. And there can be no question but that his contentions have their roots deep down in solid fact. In a second article, describing the impressive transformation in the physiography of the country affected by the formation of the huge lake in the Gatun region, during the construction of the Panama Canal, Mr. George Shiras draws a vivid picture of the destruction of animal and plant life which has been inevitable but none the less regrettable. Thickly forested valleys teeming with animal life have now been converted into one vast lake. But the author holds that this area should be converted by the Federal Government into a reservation for the absolute protection of the survivors from this deluge. In course of time, he points out, if this is done, water-fowl of all kinds will find sanctuary here, and serve as a "feeder" for the areas depleted by the sportsman.

In his presidental address, read at the American Association of Museums, San Francisco, Dr. O. C. Farrington gave an able summary of the origin and evolution of natural history museums, which should be widely read in this country. More especially is this to be urged in view of the danger which threatens such institutions in the immediate future in regard to the policy of national retrenchment which is now in process of formation. There is a danger that the pruning-hook may be used too ruthlessly, thereby inflicting material harm. For reformers are generally enthusiasts, and therefore are to be carefully watched, experience having shown that a sense of proportion is not usually among their attributes. Museums, as he remarks, are even now commonly regarded as a luxury, but he leaves no uncertainty as to the vitally important part which the modern museum plays, and must continue to play, in ever-increasing force, in our national life: widening our outlook and conceptions of existence, and affording to the uninitiated sources of information as to the nature of disease and pestilence, and other aspects of economic zoology which are indispensable to the speeding up of progress and well-being.

In *La Nature* for August 21, 1915, L. De Launay shows the extent of the recent discoveries of coal-bearing strata in Germany, Belgium, and the Netherlands. Though the ultimate ownership of some of these stores may seem uncertain, there is no doubt as to their importance in the economy of Europe. The explorations have proceeded at depths from 1000 to 1500 metres (nearly 5000 ft.). The Westphalian coalfield has thus been connected with that of south-east Belgium, through the tracing of intermediate fields between Wesel and Aachen. On the east side of the Rhine, moreover, from Essen to Wesel and Haltern, the Westphalian basin has been proved to have a vast extension. West of the Meuse, and south of the innocent lands of Nijmegen, Holland participates in the new discoveries. At the Dutch frontier the coal is within 300 metres of the surface. Since 1901, the Belgian field has been traced far northwards beneath the Cainozoic strata of Limbourg between Brussels and Maastricht, and away west into the province of Antwerp. The results in northern France have been less important, but the total coal resources of the areas dealt with in M. De Launay's article are double those that were known a few years ago. The author cannot resist a suggestion that, "after the war," France should annex the basin of the Saar.

Dr. A. Wade's researches on "The Supposed Oil-bearing areas of South Australia" have been published as Bulletin No. 4 of the Geological Survey of the State. Its wise conclusions and scientific thoroughness recommend this report as a model to be followed by explorers. The remarks about those superficial observers who stimulate unprofitable enterprises by saying that "the country is exactly like such-and-such an oilfield" should be read by financial magnates as well as by would-be prospectors.

In the fifth volume of the Journal of the Natural History and Science Society of Western Australia (Perth, 1914, price 2*s*. 6*d*.), C. G. Thorp (p. 20) reviews the interesting glassy bodies known as Australites, and gives a useful map of their distribution. He regards them as ejected from a volcano or volcanoes in the East Indies, some of them in Tertiary and some in modern times. The blebs of glass now found were attached to bubbles, and were thus carried into the currents of the cirrus-cloud level of the atmosphere. The author has succeeded in obtaining artificial glass bubbles with blebs attached; but some accident seems to have prevented their appearance among his illustrations. He believes that some of the surface-glaze in australites results from fusion while falling through our atmosphere. F. Berwerth, it may be remembered (Nature, vol. lxxxix., p. 513), used the absence of such signs of fusion in moldavites as an argument against the meteoric theory of their origin, and in this he received support from G. P. Merrill's work on australites. E. W. Skeats describes "three unusual forms of australites" from gravels in Western Victoria (Proc. R. Soc. Victoria, vol. xxvii., 1915, p. 362).

In a review of "The Origin and Formation of the Diamond" (S. African Journ. Sci., vol. xi., 1915, p. 275), W. Johnson combats the theory that the South African diamonds were formed from carbon dissolved in molten kimberlite, and urges that pressure was the primary factor in their production, at a time when the igneous ground was buried in the crust far more deeply than it is at the present day.

The Bulletin of the American Geographical Society for August, 1915 (vol. xlvii.), illustrates, in a paper by H. E. Gregory, of Yale, the huge buttes left in the Navajo country by erosion of red Permian sandstones. Wind is still the great enemy in this plateau

region, which lies between 4000 and 7000 ft. above the sea. The Colorado River is the only stream that maintains a strong flow throughout the year, and the meteorological records show great variations in rainfall from year to year, but indicate a brief rainy season in July and August. In the same number of the Bulletin, Sidney Powers, of the Hawaiian Volcano Observatory, provides some striking photographs of the lava-lake of Kilauea.

THE mineral and petrographic studies which form a special feature of the American Journal of Science are continued by W. E. Ford (vol. xl., p. 33), who investigates "the relations existing between the chemical, optical, and other physical properties of the members of the Garnet group," and in the following number by N. L. Bowen (*ibid.*, p. 161), who has experimentally investigated the crystallisation of simple types of basaltic and dioritic magmas. Mr. Bowen concludes that the more acid subalkaline igneous magmas are "derived from basic material, being, as it were, successive mother liquors from the crystallization of the basic magmas." Syenite may thus arise as an upper product of differentiation from a large slowly cooled mass of basaltic magma.

THE Canadian Department of Mines has issued recently three memoirs dealing with the coal resources of the Dominion; two are issued by the Geological Survey, namely, "Coal Fields of Manitoba, Saskatchewan, Alberta, and Eastern British Columbia," and "Coal Fields of British Columbia," both by D. B. Dowling, and one is issued by the Mines Branch, namely, "Products and By-Products of Coal," by Messrs. E. Stansfield and F. E. Carter. The two first-named deal more especially with the geology of the coal fields of western Canada, and will be welcomed by all interested in the geology of coal, more particularly because they deal with important coal deposits in relatively recent formations, Cretaceous and Tertiary. The third pamphlet will no doubt appeal to a wider public, its object being to present in a simple and accessible form the various economic applications of coal products, and, in the words of the authors, their "aim has been to give prominence to the commercial rather than to the scientific aspect of the subjects treated." Coke, gas, ammonia, tar, and the derivatives of coal-tar are briefly discussed in turn, and their economic and industrial importance is explained. Under the last head the question of the dye industry is touched upon, and the authors have quoted certain statements of Dr. Bernhard C. Hesse, of New York, which well deserve the widest possible publicity, showing, as they do, a remarkably sane and sound appreciation of the difficulties of the question. He points out that the coal-tar dye industry is not a unit, nor does it even consist of a number of independent units, but "is really a conglomerate of many separate parts acting and reacting upon each other, commercially and industrially"; his final conclusion being "that the whole of this industry cannot be successfully transplanted, and attempts to transplant part only have not resulted in any self-contained and independent industry anywhere."

THE *Monthly Meteorological Charts of the North Atlantic and Indian Oceans* for September, 1915, recently issued by the Meteorological Office, contain much which is of interest to the navigator. There is much else besides the precise detail as to the frequency of wind and current. An inset chart is given on the Atlantic issue showing the distribution of fog and mist over the ocean in September. It is shown that fog is seldom experienced on the steamer tracks in mid-Atlantic during September, and there is never as much as 20 per cent. in that month anywhere over the North Atlantic, as against 30 per cent. near Cape Race in August, and 40 per cent. in July. The Atlantic chart also contains on its reverse charts of the mean salinity and surface temperature of the North Atlantic and of the English Channel. The chart for the Indian Ocean gives graphically details of the ice in the southern hemisphere, also detailed information relative to the results of meteorological observations in the Persian Gulf and the Gulf of Oman.

ACCORDING to an article in the *Scientific American* for August 14, Dr. F. C. Brown, of the physics department of the State University of Iowa, has applied his discovery of the great sensitiveness to light of a selenium crystal as compared with the ordinary selenium film to the production of a "phonopticon" to enable blind persons to read printed matter. The instrument is a simplification and improvement of Dr. Fournier's "type-reading optophone." A box carrying a lamp, and provided with lenses, is moved along the line of print. By this means a short vertical bar of light moves along the line from left to right, and an image of the bar is cast on two or more selenium crystals in such a way that each crystal is covered by a fixed part of the line. Each crystal forms one side of a resistance bridge, which is balanced when the bar of light falls on white paper. Want of balance when the bar covers a portion of a printed letter is detected by a telephone in series with a rotating contact-maker. Each bridge has a contact-maker of a different period, and on listening to the joint effect of the telephones it has been found possible with not more than two telephones to recognise the sequence of sound for each letter of the alphabet.

WHILE the teaching of the calculus is now taken at an early stage in our curricula, the results do not appear to have been altogether satisfactory in America any more than here. We have recently received reprints of a discussion on "Practical Mathematics" opened by Prof. W. S. Franklin and his assistants before the Society for the Promotion of Engineering Education (Bulletin iv., 10, p. 5; Proceedings, xxii., p. 149), and we also have before us Prof. E. B. Wilson's reviews of recent text-books in the Bulletin of the American Mathematical Society for last June (xxi., 9). The failure of the students to profit by the course would appear to be due to the want of rigorous logical reasoning, to the failure to illustrate the subject by concrete physical and other illustrations, and to "the entire absence of suggestiveness in his mathematical studies and the inhibition of sense by the excessive formalities of ordinary

mathematics instruction." Prof. Franklin also raises certain objections to the syllabus definition of differentials, but we are sorry to see that he himself perpetuates the worst defects of our text-books by expanding series of powers of differentials. It is, of course, possible to expand $f(x+dx)-f(x)$ in powers of dx, and when the result is divided by dx the limit of the series does happen to be *equal* to the differential coefficient in most cases, but the differential coefficient cannot be *defined* as the limit of the series in question. It would be equally legitimate to expand $f(x)-f(x-dx)$ or $f(x+\frac{1}{2}dx)-f(x-\frac{1}{2}dx)$. The notion of a differential coefficient depends essentially on the assumption that the ratio of $f(x_2)-f(x_1)$ to x_2-x_1 tends to a unique limit when x_2 and x_1 both tend to the same finite limit x. Further, we think it would be much better to follow Newton's example by defining equality of differentials instead of trying to define the differentials themselves. The student who is taught always to *add* dx on to the end of x fails to grasp the very foundation of the calculus. The failing cases may be exemplified by "density" at a point *on* the surface separating two media.

We have pleasure in directing attention to the little volume entitled "Manchester in 1915," which has been issued (in Manchester by the University Press, and in London by Messrs. Longmans and Co.) at one shilling net, it being the handbook for the forthcoming meeting of the British Association. While less pretentious than many previous association handbooks, it is a noteworthy production, and one which should be of great service to those attending the meeting; it will doubtless also appeal to many residents in and adjacent to Manchester, for it contains some very readable and informing articles on institutions of, and matters pertaining to, the city; thus, a brief historical sketch is contributed by Prof. J. Tait; Prof. Tout deals with the University, Dr. Tattersall with the museum, Mr. H. Guppy with the John Rylands Library, and Prof. Hickson with the Literary and Philosophical Society. Mr. Spurley Hey has two articles on, respectively, elementary education in Manchester, and secondary schools in Manchester, and Mr. J. H. Reynolds deals with the evening-school system of Manchester. In addition to the foregoing, the volume is finely illustrated by some fourteen plates—one in colour. Both text and illustrations are beautifully printed.

The Institute of Chemistry proposes to issue a special edition (limited to 100 copies) of the history of the institute, 1877–1914, and orders for it can now be received. Any profit arising out of its sale will be devoted to the building fund.

Mr. W. H. Dines informs us that a mistake occurs in his letter in Nature of August 12 on "The Probable Error of the Amplitudes in a Fourier Series obtained from a Given Set of Observations." The passage in question should read:—"To obtain p we write $np/2=y_0\sin 0+y_1\sin\frac{2\pi}{n}$. . . . etc., instead of $p=y_0\sin 0$ . . . .

OUR ASTRONOMICAL COLUMN.

Absolute Stellar Motions.—*Meddelande* No. 65, from the Lunds Astronomical Observatory, gives an account of an important statistical study of the distribution of the absolute motions of a number of parallax stars which has been made by Mr. K. W. Gyllenberg. After excluding parallaxes smaller than 0·015″, there remain 160 stars for which absolute velocities can be determined. The components were calculated for an axis "Z" pointed to the galactic pole, an "H" axis in the plane of the Milky Way, whilst the third "Σ" was directed towards the vertex found for 1470 stars with known radial velocities. The numerical work was curtailed by using Prof. Charlier's plan of dividing the sky into forty-eight compartments, and using the co-ordinates of the centres for the contained stars. Prof. Charlier's units Siriometer (1 Sm = 10^6 dist. earth-sun) and Stellar-year (1 St. = 10^6 years) have been used (1 Sm/st. = 4·7375 km./sec.). After arranging the material according to type of spectrum, five star types, K1 (Arct.) to A2p (Cyg.), were excluded as having excessive velocities. The greatest mean velocities were found in the plane of the galaxy, the "Z" components giving the smallest mean value. The absolute velocities tend to increase as the parallax diminishes, but the increase is more rapid for the small parallaxes, probably due to the greater insecurity of these measures. Hence in the final stage of the work stars having parallaxes less than 0·025″ were excluded. It is concluded that the distribution of the absolute velocities for the remaining 144 stars is approximately represented by an ellipsoid of revolution flattened in the plane of the Milky Way, and, unlike the proper motions or radial velocities, the absolute motions show no principal vertex.

The Solar Eclipse of April 17, 1912.—We have received copies of two papers by Señor P. Carrasco, of the Madrid Observatory, reprinted from the Annals of the Physical and Chemical Society of Spain, dealing with the above eclipse. One of these papers (*Ann.*, vol. xii., pp. 482–99, 1914) gives a general description of the eclipse and of the work done at Cacabelos (Leon) by Señor Carrasco, who had charge of the spectroscopic work in the eclipse party under Señor Cos, organised by the Institute of Geography and Statistics. The central line of totality, it is estimated, passed about 2700 metres south-east from the position occupied at Cacabelos (3° 1′ 39″ W., Madrid, 42° 35′ 53″ N.). The observers saw something rather less than totality, but more than a mere partial phase. In the second paper (*Ann.*, vol. xiii., pp. 181–238, 1915) the spectroscopic observations are discussed. The prismatic camera employed had "two (?) quartz prisms of 60° angle, 48 mm. in height, with an objective of 50 mm. aperture and 630 mm. f.l." *Five* exposures were made in *ten* seconds on one plate (Agfa), 13 × 18 cm. Three of these spectra have been measured and reduced (Cornu-Hartmann formula, Rowland's solar wave-lengths, and Kayser's Hauplinien). The results are given in a table of some 2000 chromospheric lines between λλ3334 and 5897. The ultra-violet region to λ3900 has been mapped. The conclusions reached are in good accord with those now generally accepted; thus, although Fraunhofer lines are common to both spectra, yet the intensities are notably distinct, the larger chromospheric arcs agreeing better with the spark than the arc spectrum, and the principal lines of the high chromosphere correspond with the enhanced lines of Sir Norman Lockyer.

Anomalous Dispersion in the Sun.—Last year Prof. Julius, by a development of the theory of anomalous dispersion, concluded that there must be

a mutual influence of closely neighbouring Fraunhofer lines. Early in the present year, however, Dr. St. John, discussing the same data employed by Julius, obtained a negative result. The matter is now carried a stage further in the June number of the *Astrophysical Journal* by Mr. Sebastian Albrecht. In this valuable paper a comparison is made of Rowland's solar wave-lengths of iron lines and the laboratory wave-lengths of the same lines to determine whether systematic differences are shown by lines having close companion and isolated lines. The paper hinges on a discussion of laboratory wave-lengths. All iron lines which have been classified according to pressure effect were examined, and consequently a chief feature of the paper is a complete list of Rowland's solar wave-lengths and corresponding international wave-lengths of these lines. International secondary standards were, of course, adopted without modification; for other lines a comparison was made between the sea-level determinations of Burns and the Pasadena-Mount Wilson values of St. John and Ware. A systematic difference so disclosed was ascribed to differences in the *internal* pressure of the arcs employed. The corrections to reduce the I. Å. values to a pressure of 0·5 atm. (the pressure of the solar reversing layer) were applied, and differences, Row., λ I. Å. 0·5 atm., as well as Row. λ I. Å. 1 atm., were tabulated. Systematic differences between Rowland and the international system were eliminated subsequently by means of a curve. The following table concisely exhibits the principal results obtained :—

Means—Displacement according to Separation of Lines.

Lines with	Separation 0·0 to 0·2 Å	0·2 to 0·4	0·4 and greater
Companion towards red ...	+0·0103 ...	+0·0065 ...	+0·0036
,, ,, blue...	−0·0073 ...	−0·0024 ..	−0·0010

A REMARKABLE GROUP OF SOLAR SPOTS.—The solar surface has recently displayed considerable activity, and possessors of telescopes have been much interested in the number and variety of spot groups almost continually visible. One large group which appeared during three, and possibly four, rotations forms the subject of an article by M. Camille Flammarion in the July number of *L'Astronomie*. An account is given of the solar activity during the spring months, and associated terrestrial, magnetical, and electrical disturbances.

A CATALOGUE OF STAR CLUSTERS.—The star clusters shown on the Franklin-Adams chart plates have been catalogued by Mr. P. J. Melotte (Mem. Roy. Ast. Soc., vol lx., part 5). The scale of the plates has been found excellently well adapted for the purpose, the open clusters not being dispersed by excessive magnification, whilst the scale is sufficient to show the features of globular clusters down to 3′ diameter. The catalogue contains 245 entries, and in addition to the usual co-ordinates (1900), galactic longitudes and latitudes of the various objects are also tabulated. The clusters have been classified according to degree of condensation in the following scheme of four classes :—(1) Globular clusters, condensed at centre; (2) loose clusters having regular well-defined outline; (3) loose clusters of irregular outline; (4) coarse clusters. By plotting with reference to Milky Way and classification it was found that practically all lie within ±30° of the galactic plane, whilst the globular clusters also tend to concentrate in a particular longitude rather more than half lying within 30° of galactic longitude 325°.

INDIGO IN INDIA.

THAT the production of natural indigo in India is at present receiving the scientific attention which is its due must be welcome to many. The evidence that this is the case will be found in a Report on the Improvement of Indigo in Bihar, with Notes on Drainage and on Green-Manuring, by Mr. A. Howard, Imperial Economic Botanist at Pusa, and Mrs. Howard, published in 1914 by the Bihar Planters' Association, and republished this year, with a second report by the same authors, on behalf of the Pusa Agricultural Research Institute.

The old belief that the source of the natural indigo of commerce is the species of Indigofera distinguished as *I. tinctoria*, though accepted by many chemists and some botanists in Europe down to the close of last century, was singularly incorrect. That the species in question does yield indigo is true; that at one time it was a main source of the dye is possible. It is, however, improbable that any appreciable amount of commercial indigo has been derived from *I. tinctoria* during the past hundred years.

When the intercourse between Europe and India which followed the discovery of the Cape route began, there were two main centres of indigo production and export. One of these was Surat, in Western India, where the plant employed was a form of Egyptian indigo, *I. articulata*, still the staple indigo plant in Eritrea, and still to be met with as a native crop in parts of Scinde, Rajputana, and the Deccan. The other was in Southern India, especially in Coromandel, and in Ceylon. The plant grown in this area differed much from Egyptian indigo. We may speak of it as Indian indigo, though with some reserve, because a plant from which indigo is obtained in Northern Nigeria cannot be distinguished from the Coromandel one, while a form closely related to it, which is wild in Nubia and the Eastern Sudan, has by some writers been believed to belong to this species. It is not inconceivable that the cultivated plant of Southern India may, like that of Scinde, have originally found its way east from Africa, and it is possible to imagine that on its way west from its original Nubian home to Nigeria, cultivation may have induced in it the same modifications as have taken place on its way east to Madras. The point which immediately interests us, however, is the fact that the name *I. tinctoria*, as originally employed, connotes the cultivated indigo of Coromandel.

European needs induced an extension of indigo cultivation. That of the Egyptian plant spread east from Scinde to the Panjab, and thence along the Gangetic Plain to the province of Bihar, in later times so closely associated with the manufacture of indigo. The cultivation of the Indian indigo spread to Malaya in the east, to the coasts of Madagascar, Zanzibar, and Socotra in the west; somehow, this indigo has even reached Northern Queensland. But neither plant extended to Bengal, or to Indo-China and China beyond Bengal. In Malaya the cultivation of Indian indigo went on along with that of a third plant, *I. sumatrana*, which we may speak of as Malayan indigo; this plant has found its way eastward to Formosa and, during the supremacy of the Dutch in Western India, was brought from Sumatra to Malabar, where it displaced both Indian indigo and yet another dye-yielding Indigofera. This fourth plant, *I. longeracemosa*, hardly deserves a commercial name, and only calls for mention because it has found its way to the Mascarenes and Zanzibar, and is preferred there to the other dye-yielding species.

This is not the place to discuss the policy which, early in the seventeenth century, laid an embargo on

Indian indigo, or to explain how, when that embargo was withdrawn, American indigo came to replace the Indian dye in European markets. What does interest us is that this American indigo was mainly the product of a fifth plant, *I. suffruticosa*, Brazilian indigo, grown both in South America and in the West Indies, and of a sixth, *I. truxillensis*, West Indian indigo, grown both in the West Indies, where it was the favourite indigo, and in Central America. The cultivation of Brazilian indigo spread more widely than that of any other kind; it found its way all over Polynesia, and became established in the Philippines. From Manila it extended throughout Malaya, where the Brazilian, Malayan, and Indian indigos were grown side by side, and reached Formosa, where it still competes with Malayan indigo. Similarly, this Brazilian indigo has found its way into all parts of Indo-China and into south-eastern China; in Indo-China and China this American plant is the only dye-yielding Indigofera yet known. In the opposite direction, the Brazilian indigo spread to the African coast, on the western side displacing an indigo already in cultivation, on the eastern finding a place alongside various Asiatic forms. It is interesting to note that by neither route did Brazilian indigo ever reach India.

The area occupied by the Indigofera which yielded the indigo known to the ancients extended in classical times, as it does still, from Egypt and Nubia to North-West India. Immediately to the south of the region in which the Egyptian indigo grows, from the highlands of Abyssinia as far as Zululand, occurs a seventh plant, *I. arrecta*, East African indigo, the cultivation of which has spread east to the central highlands of Madagascar and west to the coast of Guinea. Along that coast, however, from Angola to Senegal, this indigo at a later date was largely supplanted by Brazilian indigo.

The circumstances which, towards the end of the eighteenth century, led to a revival of the Indian indigo trade lie outside the scope of this article. This successful enterprise had its principal seat in the three Lower Provinces of Hindustan—Bengal, Bihar, and Orissa. The plant at first grown was a form of the Egyptian indigo; this was still cultivated in Bihar in 1812. In Bengal and Orissa, where indigo had not before been grown, this Egyptian indigo, better suited to a somewhat drier climate, was soon replaced by Malayan indigo. From Bengal, where the cultivation of indigo ultimately died out, the Malayan plant extended into Bihar, displacing the Egyptian. From Bihar this plant spread westward throughout Upper India and across the Panjab to the district around Multan, which eventually became a favourite source of the seed for the Bihar crop. From Orissa, where its cultivation likewise came to an end, the Malayan plant invaded the area in South India where *I. tinctoria* was once the staple source of the dye, displacing that Indian indigo so effectually that now *I. tinctoria* is only found in the Laccadive and the Maldive Islands, and in some parts of Ceylon, where the share taken in the eighteenth-century effort to promote the cultivation of indigo was insignificant. If, however, this Malayan plant did not reach Ceylon it was taken to Senegambia, as the "Indigotier de Bengal," to replace Brazilian indigo, and was similarly taken to the West Indies to replace *I. truxillensis*.

From Senegambia the Malayan indigo has found its way as far as Northern Nigeria, where it now grows in company with a form which cannot be distinguished from the indigo once widely cultivated in Southern India. Allusion has already been made to the possibility that the latter form may have originated in Africa, but the more probable, if more prosaic, explanation of its presence in Nigeria is that when seed of the Malayan indigo was taken to West Africa from Chandernagore in Bengal, a supply of South Indian seed was also taken from Pondicherry in Coromandel. But while we know that the first transaction took place, we can as yet only surmise the second.

In the West Indies the cultivation of Malayan indigo did not take root as it did in India and in West Africa. The effects of the competition by India had made themselves felt before the Malayan plant reached the islands. Where indigo-growing was not abandoned in favour of sugar and cotton, the West Indian plant, which was at least as valuable as the Brazilian, even if it was inferior to the Malayan one, had already been displaced by an eighth species, *I. guatimalensis*, Central American indigo.

Although Ceylon took no part in the revival of the eastern indigo trade, the Dutch East Indies did. At first, as we have seen, the Indian, the Malayan, and the Brazilian indigos were all grown; later, however, the Malayan plant, just as in India, displaced all other kinds. But in Java a further step, never adopted in India, came to be taken; Central American indigo, *I. guatimalensis*, was introduced, and displaced the Malayan plant, *I. sumatrana*. Later still, yet another displacement occurred; about the middle of the nineteenth century the East African indigo, *I. arrecta*, found its way from Zululand, through Natal, to Java; by the time that the competition of synthetic indigo had begun to be serious, this African plant was practically the only indigo cultivated in Java.

Displacements of economic species depend on economic factors. In the case of indigo, the explanation has been either that the newly adopted species was found to yield more leaf from a given cultivated area or more dye from a given weight of harvested leaf; in the case of East African indigo, it would appear that Java experience has found these two advantages combined in the same species. It was not until 1898, as Mr. and Mrs. Howard explain in their First Report, that it was realised in Bihar, where the competition of synthetic indigo had at last aroused concern, that in Java not merely one, but two, displacements of the plant which was the basis of the industry had taken place since India and Malaya re-embarked upon it in the late eighteenth century. Some Bihar planters then introduced the African plant from Java; a few seasons later direct importation of seed of *I. arrecta* from Africa took place.

The cultivation of East African indigo, which is in India termed Java indigo, though it is not a native of Java, and is in Java termed Natal indigo, though it does not grow in Natal, gradually spread until 1909–10, and bade fair to displace Malayan indigo in Bihar. An abnormal season, followed by another of the same type, then led to a check. Indigo growers became so alarmed at what they mistook for an outbreak of disease that by 1913 the area under East African indigo had fallen from 70,000 to 15,000 bighas. Had their memory enabled them to recall the experience, duly recorded at the time, with regard to the cultivation of *I. arrecta* near Calcutta, under equally abnormal conditions, ten years earlier, a suspicion might have been aroused that what was needed was the correction of some defect in the cultivation and the bestowal of some attention on the seasonal peculiarities of the East African plant. The investigation of the imaginary disease was placed in the competent hands of Mr. Parnell at Sirsiah, who in 1913 was unable to report the discovery of any pathogenic organism. Mr. Howard, who then had

an opportunity of discussing the matter, came to the conclusion that the symptoms which had alarmed growers were attributable to bad cultivation and water-logging of the soil.

Since 1913 the experimental work commenced by Mr. Parnell at the now abandoned Indigo Research Station at Sirsiah has been continued at Pusa by Mr. and Mrs. Howard, whose work, as detailed in their First Report for 1914, has satisfactorily disposed of the unfounded dread that East African indigo had in India fallen a victim to some mysterious malady. In this and in their Second Report for 1915, the authors have further shown planters how a recurrence of the difficulties experienced since 1910 may be avoided, and have taught them that a treatment with which they were familiar as regards Malayan indigo calls for modification when the East African plant is in question. But they have done more than this; in the words of a writer in the Allahabad *Pioneer*, one result of the work of Mr. and Mrs. Howard is that "one bugbear of the Java indigo planter—the impossibility of obtaining good seed—is on the high-way to being removed." The beneficial effect of their work, however, does not end here; in their Second Report they point out with a directness to which the planting community have not been accustomed, that the future of their industry in Bihar will depend on their ability to increase the yield of indigo from the plant. If the advice given in the Report for 1915 be followed, there may still be some hope as to the future in store for the industry, the object of which is the production of natural indigo. It is true, as the sympathetic writer in the *Pioneer* remarks, that many improvements will be necessary if this industry is to re-establish itself. The friends of the Bihar planter—he has, and he deserves to have, many—for years past have urged this necessity upon him, and it is but fair to say that he has taken the advice to heart. But his most genuine well-wishers have not hesitated to remind him that, so far, he has failed in one important particular—he has not recognised, as he might, his own limitations. His "associations" and his "syndicates" serve many legitimate and useful purposes. But the direction of research in connection with indigo has clearly not been their *métier*, and if the two Reports by Mr. and Mrs. Howard enable this truth to be realised they will have done good which should outweigh even the immediate material benefit which they confer on a singularly deserving community.

For his attitude towards the plant and its product the indigo-planter is not wholly to blame. The stranger can teach him little with regard to the cultivation of the particular plant with which he is familiar. To his colleague the chemist there is, after all, but one indigo. When the indigo-planter knows, as the botanist tells him, that among the forty kinds of tobacco, the twenty kinds of wheat which surround his dwelling, he has to do with but one species of Nicotiana and one of Triticum; when he observes that it is easy to find two tobaccos and two wheats differing in outward characters more markedly than any two indigo plants of his acquaintance do; it is scarcely surprising if he be influenced by a subconscious belief that, after all, the indigo plants may be only forms of one Indigofera, and that the treatment suitable for one may well serve for another. Nor is it quite certain that the botanist, whose task it is to keep the planter right, is always free from a similar unwitting prejudgment. The tangled synonymy with which the history of these tinctorial species of Indigofera is loaded, and the instinctive tendency to suggest that each new one may be a modified form of *I. tinctoria*, point to this possibility. That this is not the case those who have grown the different tinctorial species together and have compared them at various stages of growth can testify; those who have made a critical herbarium study of the material available express the same judgment. Even in such as have not enjoyed these opportunities, a consideration of the history of these tinctorial indigos from a botanical point of view may perhaps induce a reservation of judgment. The hope of effecting this, and the desire to assist the planter to realise that the displacement of one indigo plant by another is nothing new and has never been unreasoned, may serve as an excuse for the *résumé* of these displacements here given.

RESEARCHES ON PHAGOCYTOSIS.

I.—*Introduction.*

ALTHOUGH the number of the white blood-corpuscles, compared with that of the red, is small (1 leucocyte to ±350 red blood-corpuscles), the absolute number of them is rather considerable; for in the five litres of blood, which is the usual quantity for a man of normal size, there are 80,000,000,000 leucocytes.

A part of these leucocytes has, owing to their plasticity, the property of enveloping and in this way taking up all sorts of particles, as, for instance, coal-dust, grains, and also bacteria. It is because of this property that these cells, which have a diameter not larger than about 0·008 of a millimetre, have engaged our attention, especially since Metchnikoff has established that bacteria englobed by these cells are killed in them, and are thus made innocuous to our body. For this reason he has called them phagocytes (eating cells), and their process of eating *phagocytosis*.

The life of these cells deserves our interest; but until now it has not been, as such, the object of a systematic investigation, a fact Metchnikoff himself regretted in a paper he read some years ago to the students of the University of Amsterdam on "Réactions Phagocytaires."[1]

Now I must confess that the importance of the phagocytes for the defence of our body against bacteria has not been the first and principal reason of my investigations with these cells: the principal reason was their being an excellent object for researches of a general biological nature.

I think a physiologist in the first place must practise science for its own sake, not asking whether his work may be of immediate practical use, but should he, however, accidentally stumble upon an idea which may be directly used for the bodily welfare of mankind, this should not prevent him from giving his attention to this; in fact, it is his duty to do so.

The phagocytes are a suitable object for studying life phenomena. In the first place, they are not such complicated organs as the muscles, heart, brain, etc.; they are simple cells, easily isolated. Secondly, it is possible to follow quantitatively the effect on their life of slight alterations of their natural medium.

It is obvious that the phenomena produced by the agency of solutions not dangerous to life are, in fact, nothing else but the effects of reactions which finally will help us to penetrate further into the physical and chemical structure of the living cell.

The investigations on the life of phagocytes, which during the last years have occupied myself and my collaborators, are a continuation of researches begun several years ago (1883) with the object of ascertaining the influence of salt solutions of various concentra-

[1] Nous ne sommes qu'au début. Lorsqu'on connaîtra mieux *la physiologie des phagocytes*, on cherchera des méthodes pour augmenter l'activité de ces éléments dans la lutte contre les microbes et on cherchera d'autres pour préserver contre l'attaque des phagocytes les cellules nobles de notre corps.

tions upon the red blood-corpuscles, and of the significance of these results with regard to the functions of the body. These researches on the red blood-corpuscles, which introduced physical chemistry into medical science, were confined to the study of their chemical and volumetrical alterations.

But the influence of the salt solutions on the very life of the cells could not well be tested on those particular objects, although systematically investigated. We have felt this from the beginning, and repeatedly asked ourselves whether the solutions producing the chemical and volumetric changes of the red blood-corpuscles had or had not seriously damaged these cells, and thus, whether it was possible to apply the conclusions arrived at to problems regarding life itself. Therefore, wherever it was possible, we examined whether the phagocytes, being submitted to the same agencies, kept their phagocytarian power. This was always the case. This conclusion enhances the value of our researches on the red corpuscles, the more so because the chemical and volumetric alterations of the white cells corresponded with those of the red ones. But a systematic study of the life of the leucocytes had not, previous to our researches, been undertaken, and this is rather surprising.

II.—*Method of Investigation.*

Our method has been very simple. White corpuscles (leucocytes) from the blood of a horse are transferred to various media mixed with very small particles of carbon. After having stood some thirty minutes in an incubator at body temperature a great many of the cells have eaten up carbon. Microscopical preparations are made, and it is ascertained what percentage of the leucocytes has taken up carbon. *This percentage is the measure for the degree of phagocytosis and gives the value of the influence of the various agents used on that function of life.*

Suppose in examining 600 leucocytes lying in their natural medium (blood serum) I find that 300 of them have taken up carbon, the percentage of phagocytosis can then be expressed by $300/600 \times 100 = 50$ per cent. In order to examine, for instance, the influence of small amounts of acid, I add this substance to the serum and repeat the same experiment under the same conditions. I now find that of the 540 examined leucocytes only 200 have taken up carbon. The phagocytosis is now expressed by $200/540 \times 100 = 37$ per cent. Thus the addition of acid to the serum has lowered phagocytosis.

This calculation is based on the principle that the phagocytic power of the individual phagocytes present in a suspension is unequal, a fact which cannot be wondered at when we take into consideration that they are of different age. The more detrimental the action of the agent, the smaller should be the number of phagocytes which take up carbon in the same space of time.

Our selection of an indifferent substance such as carbon instead of bacteria, was based upon the fact that we otherwise feared our work would become too complicated. We here refer to the fact established by Sir Almroth Wright and his school that most kinds of bacteria, before they can be taken up by the phagocytes, must undergo a certain amount of sensitisation. Hence it follows that the intensity of phagocytosis will not only be influenced by the agent, as such, but also by the degree of "sensitisation" the particles have undergone. Another fact which had to be borne in mind was that the bacteria sometimes secrete poisons, which have an injurious effect on the phagocytosis. Even dead bacteria contain poisons.

The selection of carbon as an indifferent substance instead of the usual grains of carmine was based upon the greater facility and accuracy with which the taking up of carbon can be ascertained. I shall not here give a detailed description of the method of obtaining the leucocytes, or of preparing the carbon, or of the method of determining the percentage of cells which have eaten carbon. I prefer to give some of the more striking results.

III.—Results.

(1) *The Influence of Small Amounts of Calcium.*

In examining systematically the influence of the addition of small amounts of various salts (ions) to the blood-serum, it was found that very small quantities of calcium increased the phagocytosis to a considerable extent. An addition, for instance, of 0·005 per cent. of chloride of calcium ($CaCl_2$) to the natural medium (serum) caused an increase of about 22 per cent. in the phagocytic power. This favourable effect becomes even more strongly manifest when, instead of being added to the suspension of phagocytes in serum, the calcium is added to a suspension of phagocytes in a solution of chloride of sodium (common salt), in which phagocytosis occurs almost to the same extent as in serum.

These investigations have been continued in two directions. In the first place, we asked ourselves whether the influence of calcium would also manifest itself in the living body. All experiments had hitherto been made outside the body. It will be remembered that on placing under the skin (for instance, on the inside of the thigh of a rabbit) small capillary tubes, closed at one end and filled with an extract of bacteria in a solution of chloride of sodium, phagocytes enter these tubes. This phenomenon is called Chemotaxis, and is based upon the creeping movement of the phagocytes towards the excretions and secretions produced by the bacteria.

After a certain lapse of time, the open part of the capillary tube is filled with a white column consisting of phagocytes. If, in fact, calcium promotes the activity of the phagocytes, not only in the phagocytic process described above, but also in the living body, we argued it might be expected that by calcium that mobility of the cells, which here finds its expression in chemotaxis, would be accelerated. Therefore we determined the length of the white column formed in the capillary tube with animals, either treated with calcium or not so treated.

We expected to find that in rabbits treated with calcium the white column would after the same space of time be longer than in animals not having been treated with calcium. We have used two methods, which gave the same result. I will mention one only. It consisted in injecting into the rectum of two series of animals a solution of chloride of sodium mixed for one series with calcium, and for the other without calcium, and then examining the length of the column of phagocytes penetrating into the capillary tubes.

The difference between the two series was considerable. The calcium-rabbits showed the greatest degree of chemotaxis, although the amount of chloride of calcium used was very small, viz., 0·06 gr., a quantity corresponding with that given to man in mineral waters rich in calcium. Let us add that a natural mineral water used in our experiments gave the same results as the chloride of calcium solution.

What can be said of the mechanism of this effect? The calcium, on being absorbed by the mucous membrane of the rectum, enters the blood-circulation and by this is carried into the lymph of the tissue-spaces; where the glass capillary tubes are placed. The phagocytes which are there will soon undergo the stimulating influence of the calcium thus introduced, *i.e.* their mobility will be increased and chemotaxis will be promoted.

Even without measuring the length of the phagocyte columns, we may convince ourself that our conclusion as to calcium promoting the activity of the phagocytes is the correct one. On opening the skin wound, it is immediately seen that in the mineral-water-rabbits a much thicker mass of phagocytes is gathered round the tubes than in the pure sodium-chloride-rabbits. The same thing we observed invariably in all experiments where NaCl-solution containing calcium-chloride was injected.

Taking for granted that phagocytosis is playing a part in defence against microbes, we may infer from the above that an enrichment of our blood, and through this also of the lymph spaces, with small amounts of calcium must have a favourable effect on local and other infections.

There are many experiences supporting this view. I will mention only two examples. In the first place, Sir Lauder Brunton has used with great success chloride of calcium in pneumonia. Other clinicians have also met with success along the same lines; for instance, Crombie, who some years earlier, in the hospital of Calcutta, saw the mortality decrease from 38·6 to 5 per cent. He is inclined to attribute the influence of calcium to an action on the poison excreted by the pneumonia bacteria. But for this there is no evidence. Sir Lauder Brunton has recommended calcium for getting amelioration of the heart-action. In recovery from pneumonia the amelioration of the heart-action is of the greatest importance. So it was quite rational that the famous clinician and pharmacologist advised calcium for this purpose: in the first place, because it was pointed out by the work of Sydney Ringer that calcium is absolutely necessary for the heart-function, and, on the other hand, Langendorff and Hueck had found that by the injection of calcium into the circulation of a cat the action of the heart was considerably strengthened.

Sometimes it happens that during surgical operations the heart-beat is stopped by the inhalation of chloroform. The idea occurred to me that in this case calcium might be able to be of good service. Therefore I tried to improve the heart-action by intravenous injection of calcium in animals, which had been given purposely too much of the anæsthetic. I had no success; so I began to doubt whether calcium was really capable of stimulating even the normal heart. In a number of experiments I made I found that injection of calcium had no effect on the heart-beat of a normal animal. Studying the original article of Langendorff with renewed attention, I saw that he had performed only one experiment. His great reputation had given his assertion general acceptance, and so it had become a fact in the literature. Obviously the amount of calcium in the normal blood-serum provides already just the optimum quantity for the heart function.

Thus this favourable effect of calcium in pneumonia not being explained by the influence of calcium on the heart, we had to look for another reason. It was therefore most natural to remember the stimulating action of the calcium on phagocytes, which in pneumonia play such a preponderant part.

My second argument for the probability that calcium is of importance in infectious diseases is this: labourers in lime-kilns do not get tuberculosis; in Holland these workmen cover any wound they receive with lime.

The significance of calcium has for some time past been occupying the special attention of biologists and pathologists in an increasing degree, and I shall speak of it further now, and of the cause of the promoting of the activity of the phagocytes in phagocytosis and chemotaxis by calcium, only to make one remark. We might be inclined to attribute the increase of the plasticity to a modification in the aggregation of the colloid-protoplasm-particle as a consequence of the electric charge caused by the entering of a number of bi-valent calcium ions into the cells. This explanation, however, can scarcely be the correct one here; for experiment shows that other bi-valent kations, namely, barium, strontium, and magnesium, do not augment the amœboid motion, *i.e.* of phagocytosis and chemotaxis. It must be assumed, then, that the action of calcium in this case is based upon a hitherto unknown specific biochemical property of this metal.

(2) *Influence of Iodoform on Phagocytosis.*

Everyone knows that for the last thirty years iodoform has been successfully applied in the treatment of wounds and chronic inflammations. At first it was thought that this favourable effect was based upon an antiseptic action, but the idea was relinquished when it was found that lower organisms develop fully in a medium containing iodoform. Then other hypotheses were suggested, which need not be dwelt on. They are founded mainly on iodine being split off. None of these have proved satisfactory suggestions. For reasons unnecessary to state here, we have raised the question whether the favourable effect of iodoform on local infections may be due to the stimulating effect of this substance on phagocytosis. To answer this question iodoform solutions of different concentrations in a common salt solution of 0·9 per cent. were prepared and mixed with a thick suspension of white blood-corpuscles. After having added carbon particles, the mixtures were left to themselves for half an hour in an incubator at 37° C., and then cooled down. Finally, microscopic preparations were made and examined to determine what percentage of the total number of white blood-corpuscles had taken up carbon particles. The following table contains the results of the experiment.

Concentration of Iodoform Solutions in which the Effect on Phagocytosis is still perceptible.

Fluids	Percentage of leucocytes having taken up carbon Per cent.
NaCl 0·9 per cent. (common salt solution of 0·9 per cent.)	$\frac{171}{388}\times 100=44$; $\frac{151}{345}\times 100=43{\cdot}7$ — 43·8
1 iodoform to 100,000 NaCl 0·9 per cent.	$\frac{221}{374}\times 100=58{\cdot}6$; $\frac{226}{377}\times 100=59{\cdot}9$ — 58·2
1 ,, 500,000 ,, ,,	$\frac{228}{371}\times 100=61{\cdot}4$ — 61·4
1 ,, 2,000,000 ,, ,,	$\frac{208}{398}\times 100=52{\cdot}2$; $\frac{231}{445}\times 100=51{\cdot}9$ — 52
1 ,, 5,000,000 ,, ,,	$\frac{292}{621}\times 100=46{\cdot}9$; $\frac{176}{372}\times 100=47{\cdot}3$ — 47

This table shows that, in the pure salt solution, of the 388 examined leucocytes 171 have taken up carbon, *i.e.* 44 per cent. In a parallel experiment the percentage was 43·7 per cent. Thus the average was 43·8 per cent. In the salt solution containing iodoform in a proportion 1 gr. iodoform to 100·000 gr. NaCl solution, the percentage in two parallel experiments was 58·6 and 59·9; average 58·2 per cent. Evidently the iodoform promoted phagocytosis.

These and other parallel experiments illustrate also the exactitude of the method. As a matter of course, control experiments have been made in all cases.

Further, it appears that a weaker solution of iodoform (1 : 500,000) yields a still higher phagocytosis (61·4 per cent.). The explanation of this phenomenon will afterwards be given. It is seen that in still weaker concentrations the phagocytosis is diminished, but even in a solution of 1 iodoform to 5,000,000 salt solution, the promoting effect of iodoform is still perceptible, for it is 47·1 per cent., whereas in a pure NaCl solution it was $\frac{1}{2}(44+43{\cdot}7)=43{\cdot}9$ per cent.

The favouring effect of iodoform is still more evident when the leucocytes are placed for several hours in a pure NaCl solution. Then the phagocytosis falls to a considerable extent. Sometimes the phagocytes are quite paralysed. The addition of iodoform in a concentration 1 : 5,000,000 then raises the phagocytic power by 30 per cent. or more. Thus there is no doubt that iodoform is able to promote phagocytosis. *Is it the iodine or the iodoform as such?* We have found that iodine is noxious in a high degree. We must conclude, therefore, that iodoform as such causes the increase of the phagocytic power.

The question now suggests itself: How can the favourable effect of iodoform be explained? It may be accepted from numerous investigations that the outer layer of the cells consists of a fatty substance, a so-called lipoid membrane. Now iodoform is soluble in fat, and it is quite obvious that such a membrane will grow more soft and more flexible after having absorbed iodoform, and that consequently the plasticity and mobility will be facilitated.

If this interpretation be correct, then other substances soluble in fat, such as chloroform, chloral, alcohol, benzine, camphor, fatty acids (propionic, butyric acids) should affect phagocytosis in a similar way. This is found to be invariably the case.

(3) *Effect of Chloroform, Alcohol, Camphor, Benzine, and other Substances Soluble in Fat on Phagocytosis.*

I shall not give an account of all our experiments made in this direction. I only give as an example an experiment with chloroform, from which one can at once get an idea as to the exactitude of the method. It was soon found that dilutions 1 : 2000, 1 : 6000, and also 1 : 10,000 paralysed the phagocytes. The following table contains some experiments with weaker solutions:—

Effect of Chloroform on Phagocytosis.

Fluids	Percentage of leucocytes having taken up carbon	Per cent.
NaCl 0·9 per cent.	$\frac{174}{428}\times 100=40{\cdot}6$; $\frac{238}{562}\times 100=41{\cdot}2$	40·9
Chloroform 1 : 20,000	$\frac{244}{480}\times 100=50{\cdot}8$; $\frac{225}{451}\times 100=49{\cdot}8$	50·3
,, 1 : 100,000...	$\frac{254}{519}\times 100=60{\cdot}6$; $\frac{382}{455}\times 100=60{\cdot}1$	60·3
,, 1 : 500,000...	$\frac{332}{582}\times 100=57$; $\frac{219}{370}\times 100=59{\cdot}1$	58
,, 1 : 5,000,000	$\frac{379}{868}\times 100=43{\cdot}6$; $\frac{298}{661}\times 100=45$	44·3

From this table it appears that chloroform 1 : 20,000 raises the phagocytosis power from 40·9 per cent. to 50·3 per cent.; further, that phagocytosis is considerably increased by chloroform 1 : 100,000, in which case it rises to 60·5 per cent. Evidently in the chloroform-solution 1 : 20,000 the paralysing influence also makes itself felt. In a dilution of 1 : 500,000 the favourable effect remains to about the same extent as in 1 : 100,000, and finally in a solution of 1 chloroform to 5,000,000 NaCl-solution, this favourable effect is still visible, though slight.

Similar results were obtained with benzine, camphor, turpentine, alcohol, chloral, fatty acids (propionic and butyric), and also Peruvian balsam. These all, without exception, promoted phagocytosis. Hence our hypothesis for explaining the effect of iodoform was fully confirmed. Another strong support to our hypothesis was obtained by comparing the concentrations of the named substances which were able to increase phagocytosis. It appeared that the relation between these concentrations corresponded with that existing between the solubility of these substances in fat.

Further, all the substances applied in very small doses showed a stimulating effect, but paralysed when given in greater quantities. This can be explained by distinguishing two factors. First, slight quantities of the substance by dissolving in the outer layer of the cell weaken it and increase the plasticity and mobility. Then, greater quantities having entered the cell, a second factor, the paralysing effect on the protoplasm, comes into play. As the amount of chloroform is increased, the paralysing effect gets the precedence and no carbon at all is taken up.

4. *Other Phenomena seen in the Light of the Foregoing Facts.*

The effect of fat-dissolving substances on phagocytes throws a new light on several facts which were until now for the most part entirely unexplained. In the first place, we may refer to the power of turpentine to cause local exudations, and the favourable effect of a subcutaneous injection of the same substance in the treatment of pneumonia with horses and of mastitis with cows, which for some time has been practised with great success in France, Denmark, and Holland. Experiments made by us in this direction have shown that there is much reason to attribute this effect to very small quantities of turpentine dissolving in the lymph of tissue-spaces and afterwards entering the blood circulation and promoting the phagocytic power of the phagocytes in lung and udder.

In the same way we can explain the marked effect of camphor-treatment in inflammatory processes of the uterus and its adnexa, an effect not understood hitherto. Then there is the great effect of covering infected wounds with "balsam of Peru," the therapeutic value of inhalation of turpentine-vapour in tuberculous and other infectious processes in the respiratory organs.

In all these cases a stimulating action on the phagocytes, and probably also on other cells (granulation-cells), which play a part in the healing process, may come into play. Yet more becomes clear to us from the above researches.

It is well known that various narcotics applied in smaller doses have a stimulating effect and paralyse in greater quantities. Engelmann observed this many years ago on ciliated cells, but he did not try to explain it. Also as regards the nervous system we know with regard to chloroform and ether that, when administered, they first cause excitement and afterwards insensibility. So far as we know, this contrast has never been explained, but when viewed in connection with our experiments, the phenomenon becomes clear. In the beginning of narcosis only small quantities have entered into the nerve cells. The consequence is a softening in the first place of the outer layer. This weakened state of the cells produces an

increase of activity (amœboid motion?). Later, when a greater amount of the substance has been taken in, the paralysing effect gets the upper hand. With alcohol the same experience is well known.

In following this point we are led to think of the remarkable influence of a sojourn in high mountain regions, on metabolism, on sleep, and on the state of the mind. The cause is entirely unknown. It has been proved that these phenomena are not due to the height as such, for in balloons they do not occur, nor are they found in high mountain regions, but when examining where they are observed, we find that it is in the neighbourhood of coniferous woods. So we are inclined to think that it is due to the stimulating effect of the odour of resin (turpentines, etc.) on the nerve-cells.

Prof. Sherrington and Miss Sowton, in their studies on the dosage of the mammalian heart by chloroform, found that, especially with greater amounts of the drug, it was usual for the first effect of the administration to be a distinct though slight increase in amplitude of the contractions. After cessation of the administration of the drug in moderate dose, it was not unusual before the recovery of the beat for the heart to pass over for a short time into a condition of super-activity. These phenomena suggest an irritative excitatory effect of small doses of the substance on muscle or nerve-fibres (or both) of the heart. These results agree with those previously obtained by Prof. A. D. Waller in his experiments with the isolated nerve.

There are experiments also with other organs which may be considered in the same light. Thus Prof. J. Loeb discovered that substances dissolving fat have the power of rendering possible the parthenogenetic development of eggs. Now we may imagine, with Loeb, that the substance dissolves in a lipoid of the outer layer of the egg, thus giving rise to the formation of a fertilising membrane. We think we may safely go one step further and assume that it is owing to the weakening of the membrane that the movement of the protoplasm underlying every cell division manifests itself. This view is confirmed by the observation of Prof. R. S. Lillie, who saw also that by a short transitory raising of the temperature in the eggs of starfishes a typical fertilising membrane may be formed, which formation is followed by the development of part of the eggs into larvæ. J. Loeb was able to confirm this for Medusæ.

After consideration of the foregoing facts and suggestions, we were inclined to think that the stimulating effect of traces of substances which dissolve fat on the activity of cells is a widespread phenomenon. Hence we have investigated whether this influence might also be seen in *plant-cells*. To do so, we chose the germination of seeds, a process in which a considerable division and growth of cells manifests itself. The seeds we chose were grains of wheat, and for the fat-solvent we took chloroform. With chloroform, 1 part to 100,000, an important acceleration in the germination was observed; chloroform 1 to 1000, on the contrary, impaired the germination, evidently because a second factor made itself felt, viz. paralysis of the protoplasm. Later I heard that in practice the growth of snowdrops is promoted by ether. In recent times Chiari succeeded in forcing blossoms to a considerable extent by ether-vapour, and Mansfield the germination of pumpkin-seeds by vapour of alcohol and ether.

Hence it is clear that the observations on phagocytosis deserve our attention on general grounds as well as special. We do not at all mean to say that all substances dissolving fat have the same effect on cells of all kinds; far from it. I would emphasise that, in order to be brief and to avoid complexity of detail, I have here presented the matter somewhat simpler than it really is. Nor have all the suggestions here made towards explaining facts regarding other cells than phagocytes been actually proved. Without hypothesis, science cannot progress. Fortunately we need not stay in error for long, for we can always appeal to the supreme judge, experiment.

This account of results and views, the fruit of some years' work with several collaborators (Hekma, de Haan, etc.),[2] being of necessity incomplete, I have attempted to select what may specially interest the general scientific reader.

We are continuing our study of the biology of phagocytes, and each day we become more convinced of their excellence as a simple object, for the study of problems of a general biochemical nature, and for some of practical interest as well.

H. J. HAMBURGER.

IRELAND'S INDUSTRIAL OPPORTUNITIES.

A LECTURE delivered in April last before the Insurance Institute of Ireland by Mr. George Fletcher, the assistant secretary of technical instruction, and recently issued in pamphlet form, deserves the serious attention of all well-wishers of Ireland. We have in Ireland a population little more than half of what it was in 1841, and which is now annually depleted by emigration to such an extent that any increase in its population is well-nigh impossible.

It is obviously, therefore, of the highest possible importance to the well-being, not merely of Ireland, but also of the kingdom generally, that means should be taken to ensure the utmost development alike in agriculture as in manufactured products, since it is now clearly realised that it is only by a combination of both that the well-being of Ireland can be firmly established.

The Department of Agriculture and Technical Instruction established in 1899, mainly through the strenuous efforts of Sir Horace Plunket, the first vice-president, has done much for the promotion of agriculture and its products and of manufacturing industry. Improved methods have been introduced into farming, fishery, and industrial operations, especially in the latter case by the encouragement of cottage industries, with a view to find employment for the rural population in times and seasons not devoted to agricultural work, and with a view also to add to the interest of an otherwise monotonous life.

Large sums have been spent as a result of local and Governmental effort in the promotion of technical education, with the result that now practically all over Ireland facilities exist for the due training of the workers engaged in agricultural and industrial pursuits. At the same time, the Department has persistently urged the necessity, if technical training is to be of any real value, of a better and more pervading system of elementary and secondary education upon which to found it, and also for the reason that it is desirable to widen by means of a sound general education the mental horizon of the people.

Believing that no permanent good can be ensured except by the co-operation of the people themselves, it has been the aim of the Department to encourage the formation of associations of farmers and manufacturers, so as to secure a sense of solidarity and of common effort.

[2] A full account of the researches as far as the year 1912 can be found in my monograph "Physikalisch chemische Untersuchungen über Phagozyten. Ihre Bedeutung vom allgemein biologischen und pathologischen Gesichtspunkt." (Wiesbaden: J. F. Bergmann, 1912.)

The example of Denmark has proved a potent influence in the measures which have been taken to develop the agricultural resources and products of Ireland. The export value of eggs, butter, beef, mutton, pork, bacon, and hams from Ireland was in 1912 11,820,356*l*., but in 1913 we received from Denmark alone butter, eggs, and bacon to the value of nearly twenty-two millions sterling.

It cannot be said that this huge difference in value is attributable to a better soil or climate, and, as a matter of fact, it is entirely due to the better education of the people, to a more scientific treatment of the soil and of the animals concerned, and to a stronger sense of the advantages of co-operative effort. It is clear that given these conditions, Ireland, with its much larger acreage and more productive soil, could raise for export the greater part of this importation of food products; and as with agriculture, so with the smaller factory and cottage industries. It is made clear in Mr. Fletcher's address that there is abundant scope for their establishment and development, of which Belgium affords a striking and pregnant example, which the people of Ireland would do well to follow, and thus bring the small town and the countryside into close and harmonious relation.

J. H. REYNOLDS.

AEROPLANE STABILITY.

SOME phases of fore-and-aft or longitudinal equilibrium in flying are discussed by Dr. Orville Wright in a recent publication of the Smithsonian Institution, entitled "Stability of Aeroplanes." Although a beginner finds most difficulty in mastering the lateral control, it is his lack of knowledge of certain features of the fore-and-aft equilibrium which leads to most of the serious accidents.

In an ideal flying machine the centre of gravity would lie in the line of the centre of resistance to forward movement and also in the line of thrust, but in practice this is not always feasible, since the machine must be built to land safely as well as to fly. In flying, a low centre of gravity—that is, one below the centre of support, causes an oscillating movement about the lateral axis like that of a pendulum. On the other hand, a high centre of gravity tends to cause the machine to roll over in landing, and consequently a compromise is adopted.

The two principal methods used in preserving fore-and-aft equilibrium have been the shifting of weight so as to keep the centre of gravity in line with the changing centre of lift, and the utilisation of auxiliary surfaces, known as elevators, to keep the centre of pressure in line with a fixed centre of gravity. The first method has been found impracticable on account of the impossibility of shifting large weights quickly enough, but the second is used in most of the modern flying machines.

Flying machines of the latter type should have their auxiliary surfaces located in the front or rear as far as possible from the main bearing planes, because the greater the distance the greater is the leverage, and consequently the smaller the amount of surface required. No part of either the main surface or auxiliary surface should be exposed on their upper sides in a way to create a downward pressure for maintaining equilibrium.

The downward pressure of air is used to some extent, however, on account of its adaptability, in producing more or less inherent stable aeroplanes. Dr. Wright describes an aeroplane in which equilibrium is maintained by an arrangement of surfaces so placed that when a current of air strikes one part of the machine, creating a pressure that would tend to disturb the equilibrium, the same current striking another part creates a balancing pressure in the opposite direction. This compensating or correcting pressure is secured without the mechanical movement of any part of the machine. While this system will control a machine to some extent, it depends so much on variation in course and speed as to render it inadequate to meet the demands of a practical flying machine.

In order to secure greater dynamic efficiency and greater manœuvring ability, auxiliary surfaces mechanically operative are used in present flying machines instead of the practically fixed surfaces of the inherently stable type, but they depend to a greater extent upon the skill of the operator in keeping equilibrium. If the operator were able to "feel" exactly the angle at which his aeroplane meets the air, at least 90 cent. of all aeroplane accidents would be eliminated. Instruments for this purpose have been produced, but they are not in general use. The average flier does not realise how dangerous it is to be ignorant of this angle, nor does he know when he is "stalling." By "stalling" Dr. Wright means coming to rest in the air, or nearly so.

The danger from "stalling" comes when the operator attempts to check the machine's downward plunge by turning the main bearing surfaces to still greater angles of incidence, instead of pointing the machine downward, at a smaller angle of incidence, so that the speed can be recovered more quickly. Most of the serious accidents in flying occur, after long glides from considerable heights with the power reduced, when an attempt is made to bring the machine to a more level course several hundred feet in the air. The machine quickly loses its speed and becomes "stalled." Those who have seen the novice make a "pancake" landing have seen the beginning of a case of "stalling" which might have been fatal had it taken place at a height of 100 or 200 ft. in the air.

The greatest danger of flying comes from misjudging the angle of incidence. If a uniform angle were maintained, there would be no difficulty in securing fore-and-aft equilibrium. Experiments made during the past year or two have brought about a considerable advance in the development of automatic stability. A device described by Dr. Wright comprises a small horizontal wind-vane so mounted on the machine as to ride edgewise to the wind when the machine is flying at the desired angle of incidence. In case the machine varies from the desired angle, the air will strike the vane on either its upper or lower side. The slightest movement of the vane in either direction brings into action a powerful mechanism for operating the controlling surfaces. If the wind strikes the vane on the underside the elevator is turned to cause the machine to point downward in front until the normal angle is restored, and if the air strikes the vane from above, an opposite action upon the elevator is produced. The author maintains that a machine so controlled is not liable to "stalling." Another method for maintaining fore-and-aft equilibrium utilises the force of gravity acting on a pendulum or tube of mercury, and a second employs the gyroscopic force of a rapidly revolving wheel. In both these systems, however, the angle of the machine is regulated with reference to the horizontal, or some other determined plane, instead of the angle of the impinging air. Other faults render the pendulum and mercury tube useless in regulating fore-and-aft equilibrium, although the pendulum is found to be useful in regulating the lateral stability.

MINERAL INDUSTRY OF CANADA.

THE Canadian Department of Mines has issued, almost simultaneously, the annual report on the mineral production of Canada during the calendar year 1913 and the preliminary report on the mineral production of Canada during the calendar year 1914. Neither of these reports presents any feature of outstanding interest, except that the effect of the war upon the mineral industry of Canada is here made evident. The value of the output in 1913 showed an increase of 7·84 per cent. upon that of the previous year, whilst that for 1914 shows a decrease of 11·8 per cent. from that of 1913. It is, of course, not absolutely clear that the decrease is wholly due to the war. For example, the silver production of Canada, which showed a slight decrease already in the former year, has fallen about 16 per cent. in the latter year; the silver production is due in very great measure to the output of the Cobalt district, Ontario; in 1904, when the production of this district commenced, the annual production of silver was 3½ million ounces, whereas in 1910, when it reached its maximum, it was nearly thirty-three million ounces, and silver ranks second in total value only to coal amongst the mineral products of Canada, having amounted to 14·4 per cent. of that total in 1913. Both the amount of silver and the grade of the ore got in the Cobalt district have shown a gradual decline of recent years, and there appear to be some reasons to suppose that the life of the mines in this district is not likely to be a long one. A decrease in silver production might therefore have been expected normally, and it is quite possible that the part played by the European war in the recorded decrease is not an important one. Other decreases, such as those in coal, pig-iron, cement, and clay products, are, on the other hand, to be referred in all probability entirely to the war crisis. The three former showed substantial increases in 1913 over the previous year, and although the clay products fell off in value in that year, this was due merely to a temporarily decreased demand for brick, owing to the unfavourable financial position, which seriously limited building operations in the Dominion. A careful study of the two reports indicates no ground for supposing that the mineral industry of Canada is in other than a thoroughly sound condition, or that its expansion in the future will be unable to keep pace with any demands that may be made upon it.

EXPLOSIVES.

THE Smithsonian Institution, Washington, has recently issued an article by Major Edward P. O'Hern, of the Ordnance Department, U.S. Army, which deals with the composition, methods of employment, and results obtained with explosives.

The author divides explosives into three classes: progressive or propelling explosives, known as low explosives; detonating explosives or high explosives; and detonators or fulminates. For all classes the effect of the explosion is dependent upon the quantity of gas and heat developed per unit of weight and volume of the explosive, the rapidity of the reaction, and the character of the confinement, if any, given the explosive charge. The rapidity of reaction varies greatly with different explosive substances and with the manner in which the explosion is started.

Black gunpowder, smokeless powder, and black blasting powders are known as low explosives, for certain of which, such as smokeless powder, the explosion does not differ in principle from the burning of a piece of wood or other combustible. The combustion is very rapid, but is a surface action proceeding from layer to layer until the grain is consumed. Such materials are known as low or progressive explosives, although the total power developed through the combustion of a unit weight may be very great, and would be destructive unless properly controlled.

In high explosives, such as dynamite, nitroglycerin, gun-cotton, some blasting powders, and most of the "permissible explosives" approved by the U.S. Bureau of Mines for use in mines where gas explosions are liable to occur, the progress of the explosive reaction is not by burning from layer to layer, but the breaking up of the initial molecules gives rise to an explosive wave which is transmitted with great velocity in all directions throughout the mass, and causes its almost instantaneous conversion into gas. The velocity of propagation of the detonating wave has been determined for some materials to be more than 20,000 ft. per second, or approximately four miles per second; this form of material is used in shells and for bursting purposes. The progressive emission of a gas from a low explosive, such as burning gunpowder, produces a pushing effect upon a projectile, whereas the sudden conversion of an equal weight of material into gas, as would happen with a high explosive such as dynamite or nitroglycerin, would develop such high pressure and shattering effect as to rupture the gun.

The action of fulminates is much more brusque and powerful than that of the high explosives. Since they can be detonated by shock or the application of heat, they are used in primers and fuses to start action in both low and high explosives. The most important is fulminate of mercury, which produces a pressure of about 48,000 atmospheres.

At no time in the history of the world have explosives played such an important part in deciding the destiny of nations as they are playing to-day in the prosecution of the present war. Their extensive use in the mighty engines of destruction, such as the submarine mine, the torpedo, and in projectiles thrown from cannon to great distances with marvellous accuracy, is resulting in loss of life and destruction of property on an unprecedented scale.

Beginning with black powder, the earliest record of which in actual war was in the fourteenth century, the author follows the development of powder through its early stages of brown powder to the two principal forms of smokeless powder for military purposes—nitro-cellulose and nitro-glycerin—stating that the use is quite evenly divided; the U.S. Army and Navy, the French Army and Navy, and the Germany Army using the former, and the British Army and Navy and the German Navy using the latter. He then gives much detailed information concerning the manufacture, life, source of supply, and tests of smokeless powder manufactured from nitro-cellulose or gun-cotton. Following which, subjects relating to life of guns, bursting charges for projectiles, armour-piercing projectiles, high explosive shells, shrapnel, fuses, aeroplane bombs, means of igniting explosives, mines, torpedoes, and the storage and shipment of explosives in the United States are discussed.

THE BONAPARTE FUND FOR THE YEAR 1915.

THE committee appointed to consider the requests for assistance from this fund have examined twenty applications, and made the following proposals, which were accepted by the Academy:—

3000 francs to Auguste Lameere, professor at the University of Brussels, to assist him to continue his researches at the zoological station of Roscoff.

4000 francs to M. Le Morvan, assistant astronomer

at the Paris Observatory, for the publication of the photographic and systematic chart of the moon.

2000 francs to Paul Vayssière, to assist him in the continuation of his researches on cochineal insects.

3000 francs to M. de Zeltner, as a contribution to an expedition he proposes to make in the Sudanese Sahara, more particularly in the Aïr massif.

2500 francs to L. Bordas, to aid in his investigations relating to insects which attack forest trees, and more especially of those species now causing great damage in the woods of the Central Plateau and the west of France.

3000 francs to Joseph Bouget, for realising his cultural experiments on a larger scale, with reference to the afforestation and improvement of pastures in the Pyrenees.

3000 francs to Henry Devaux, for the continuation of his researches on the cultivation of plants in arid or semi-desert regions.

2000 francs to Victor Piraud, to enable him to continue his studies on the fauna of torrents and Alpine lakes, particularly at high altitudes.

2000 francs to M. Tiffeneau, for the continuation of his studies on the phenomena of molecular transposition in organic chemistry.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The following awards at Newnham College have been made:—An associates' fellowship of 100*l.* for three years, tenable from October, 1915, to Miss Ruth Holden, who proposes to continue her work in fossil botany; a Mary Ewart travelling scholarship of 300*l.*, divided between Miss H. J. Hartle and Miss M. N. L. Taylor; the Mary Ewart scholarship of 100*l.* for three years to Miss K. M. Tillyard; the Marion Kennedy studentship of 100*l.* to Miss E. E. H. Welsford; the Gilchrist studentship of 100*l.* to Miss C. Stoney; a Bathurst studentship of 75*l.* to Miss M. W. Jepps; the Harkness studentship of 70*l.* to Miss E. W. Gardner; the Arthur Hugh Clough scholarship to Miss P. M. Sargent.

LEEDS.—The William Walker scholarship, of the annual value of 90*l.*, for the scientific study of leather with a view to its subsequent application to industrial development, and the William Walker exhibition for instruction in the technology of coal and its by-products, are announced. The endowments have been founded in memory of the late William Walker, of Whitehaven, by his widow and two sons, who have placed 4500*l.* in trust for the purpose.

THE Institution of Naval Architects' scholarship, value 100*l.* per annum, and, subject to the regulations governing the same, tenable for three years, has been awarded to T. S. D. Collins.

MR. G. H. SHULL, of the staff of the Station for Experimental Evolution, Cold Spring Harbour, Long Island, has been appointed professor of botany and genetics at Princeton University, Princeton, New Jersey.

THE issue of the *Lancet* for August 28 is the "Students' Number," devoted almost entirely to information respecting the medical examining bodies and the courses of instruction given in the various medical schools and colleges of the United Kingdom.

THE following appointments to the Indian Educational Service have been made by the Secretary of State for India:—Mr. Harold Tinker, professor at the Training College, Allahabad; Mr. G. H. Geach, principal of the Training College, Peshawar; Mr. W. Saunders, professor of chemistry in the Civil Engineering College, Sibpur, Bengal; Miss E. E. Spencer, inspectress of schools in the United Provinces.

AN examination in biological chemistry, bacteriology, fermentation, and enzyme action will be held in connection with the Institute of Chemistry, beginning on October 18. The list of candidates will close on September 14. An examination in chemical technology will be held in October, but the actual date will be announced later. Notification from intending candidates must be received by September 14.

WE are informed that Mr. E. Lovett, who has formed a collection of children's toys, playthings, and games, has presented the collection to the Borough Council of Stepney, and that it is to be exhibited at the Whitechapel Museum. It will be arranged in ten sections, viz., locomotion and transport, dolls, animals, habitations, farming and agriculture, mining, manufactures and commerce, the household, playthings, games, sundries, *i.e.* toys and games of antiquity; toys made of natural objects, such as shell, bone, stone, nuts, etc.

THE Department of Agriculture and Technical Instruction for Ireland has issued a number of pamphlets in preparation for the work of the coming academic year. These include the "Programme for Technical Schools and Classes," in which it is pointed out that the regulations for technical schools and classes which were in operation during the session 1914–15 will continue in force during the session 1915–16. The "Programme of Experimental Science, Drawing, Manual Instruction, and Domestic Economy for Day Secondary Schools" has undergone no alteration, and the work next year will follow on the lines previously laid down. The "Special Course in Experimental Science: Physiology and Hygiene" has been revised.

THE Education Committee of the Staffordshire County Council has issued its "Directory for Higher Education, 1915–16." The directory contains the regulations of the committee and details of schemes in operation throughout the administrative county. Owing to the necessity of publication before the commencement of the new session it has not been possible to make final arrangements with regard to some of the classes, and, as the directory points out, some readjustments and alterations may be necessary later. One or two typical instances of the thoroughness with which the committee has provided for the needs of the county in higher education may be given. On account of differences of character between the North and South Staffordshire coalfields, and for other reasons, separate schemes of instruction in mining have been worked out for the two districts. Such instruction in the North Staffordshire coalfield is provided by the County Education Committee and the Education Committee of Stoke-on-Trent working in co-operation. The principal centre at which instruction is given is the Central School of Science and Technology, Stoke-on-Trent. This is a specialised school adapted to the needs of potting and mining, the principal industries of the district, and equipped for the study of the technology of these industries up to the most advanced grade. In South Staffordshire a general scheme of instruction in mining is designed to extend over six years, and classes in connection with it are held at several centres. At the new County Metallurgical and Engineering Institute, Wednesbury, theoretical and practical classes are held in metallurgy, iron and steel manufacture, and subjects related to engineering. Other branches of technological science in which special facilities have been provided are:—Pottery and porcelain manufacture, boot and shoe manufacture, silk manufacture, and horticultural and smaller agricultural industries.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 23.—M. Ed. Perrier in the chair.—G. **Humbert**: The reduction of the forms of Hermite in an imaginary quadratic body.—MM. **Costantin** and **Bois**: Three types of commercial vanilla of Tahiti. Since three-fifths of the world's production of vanilla comes from the French colonies, the question of its culture is worthy of investigation. The fruit from Mexico and Reunion is superior to that of the Tahiti type. In the present note a comparison is made between the types of vanilla known under the names of Mexico, Tahiti, and Tiarei, and some practical suggestions are made for cultivation.—Paul **Vuillemin**: The staminal origin of the perigon of the Liliaceæ; proofs furnished by the flowers of Hemerocallis.—E. F. **Perreau**: An electro-vibrator worked with interrupted currents. Previous types of this instrument, used in surgical work, have been worked with an alternating current, but an interrupted continuous current may be also used with advantage. Details of the arrangement are given, which, for the detection of non-magnetic bodies, is superior to the original instrument.—Daniel **Berthelot**: The co-volume of the gases disengaged by explosive materials. The co-volume b, in the equation $p(v-b)=RT$, is usually taken as 0·001 in calculations relating to explosives. It is now shown that this only holds for gases the critical temperature of which is sensibly equal to four times the critical pressure.—M. **Guilbaud**: An apparatus for the photolysis of powders.—J. **Repelin**: The Cretaceous age (Begudian) of the detritic layers of Logis de Nans (Var).—Henry **Hubert**: Subterranean waters in western Africa. A chart of Senegal is given showing the depths of the underground water.—Jules **Amar**: Arthrodynamometric measurements. — H. **Vincent**: Typhoid toxin and the production of a specific serum against typhoid fever. A study of the conditions for obtaining cultures of high toxic power.

WASHINGTON, D.C.

National Academy of Sciences, August 15 (Proceedings No. 8, vol. i.).—J. **Loeb**: Weber's law and antagonistic salt action. The author had shown that the ratio of the concentrations of antagonistic ions must remain within certain limits for the normal functioning of an organism. It is here shown that these limits remain approximately constant as the concentration of one of the ions is changed.—E. L. **Nichols** and H. L. **Howes**: The polarised fluorescence of ammonium uranyl chloride. The remarkable fluorescence spectrum of this salt is described in considerable detail, observations being made at +20° C. and −185° C.—T. **Michelson**: The linguistic classification of Potawatomi. By study of the so-called verbal pronouns, which afford most satisfactory classificatory criteria, it is shown that Potawatomi belongs to the Ojibwa group of Central Algonquian dialects.—H. **Shapley** and Martha Betz **Shapley**: The light curve of XX. Cygni as a contribu- to the study of Cepheid variation. The form of the maximum of brightness in XX. Cygni is variable from period to period, and thus suggests the hypothesis that the periodic light and spectrum variations in this and other Cepheid variables should be ascribed to internal vibrations producing irregularities in luminosity instead of to double-star phenomena.—C. B. **Davenport**: The feebly inhibited. III.—Inheritance of temperament, with special reference to twins and suicides. A statistical study on eighty-nine family histories, affording 147 matings, leads to the conclusion that temperament is inherited as though there were in the germ plasm a factor E, which induces the more or less periodic occurrence of an excited condition and its absence, *e*, which results in a calmness; also a factor C which makes for normal cheerfulness and its absence, which permits a more or less periodic depression, the factors behaving as though in different chromosomes, so that they are inherited independently. —H. **Shapley**: Second-type stars of low mean density. Because of its bearing on the question of the order of stellar evolution, the density of stars of the second spectral type is discussed from the point of view of the dependability of the observational and theoretical work that is the basis of the derivation of occasional extremely low values.—W. H. **Brown** and Louise **Pearce**: The pathological action of arsenicals upon the adrenals. That arsenicals of diverse chemical constitution exert pronounced pathological action upon the adrenals has not been generally recognised. It appears from these observations that the adrenotropic action of arsenicals is one of the most constant and important features of arsenical intoxication, and it is suggested that therapeutic doses of some arsenicals may be found to produce definite stimulation of the adrenal glands.—Louise **Pearce** and W. H. **Brown**: Variations in the character and distribution of the renal lesions produced by compounds. Not all compounds of arsenic produce vascular lesions; some are capable of producing tubular nephritis; the difference in the pathogenic action being explainable only upon the basis of the chemical constitution of the different compounds of arsenic.—H. S. **White**: Seven points on a twisted cubic curve. If seven points on a twisted cubic be joined, two and two, by twenty-one lines, then any seven planes that contain these twenty-one lines will osculate a second cubic curve.

CAPE TOWN.

Royal Society of South Africa, July 21.—Dr. L. Péringuey, president, in the chair.—S. H. **Haughton**: Exhibition and description of a new type of fossil reptile from the Karroo. A somewhat incomplete skull, with associated limb-bones and vertebræ, from the upper Tapinocephalus zone of the Beaufort West District were exhibited. The form seems to show affinities both with the Dinocephalia and the Gorgonopsia. In the general form of the skull and of the palate it recalls the Dinocephalia, although it is much smaller, and its maxillary and premaxillary teeth are herbivorous, like those of Tapinocephalus and other forms; but in the possession of a few small palate teeth, in the vertical occipital plate, the shallowness of the basicranium and some other features it recalls the Gorgonopsia. The form occurs in beds which contain members of both groups, although the larger Dinocephalia of lower horizons seem to have given place to smaller forms. Watson has contended that these two groups have arisen from a not very far distant common ancestor; and although this form cannot be looked upon as ancestral, it throws some further light on the relationships between the two groups.—K. H. **Barnard**: Conus shells illustrating variation in markings. A series of shells was exhibited, showing gradation in the pigment from a condition in which the coloration is strongly marked to that in which the shells are practically colourless. The question of the origin of the pigment in its relation to the environment and heredity of the mollusc was discussed.—S. J. v. d. **Lingen**: (1) Simple apparatus for finding "G"; (2) simple apparatus for standardising a given vibrator. Apparatus was described the use of which does not involve assumptions of dynamical quantities that the student cannot determine for himself, and which is adapted to give him some definite idea about the acceleration of a freely falling body. A piece of apparatus was also described by which velocities and accelerations of trolleys, etc., can be determined without the need of assuming the

time of vibration of some vibrator.—J. K. E. **Halm**: Astronomical photometry. An account was given of a method which claims to derive from the measured diameters of the star discs on a photographic plate the brightness or "magnitude" of any star on a self-consistent basis. The work is founded on the examination of the properties of the photographic plate in the light of experiments made by Abney and Kron. The results obtained for the stars of the Cape astrographic zones demonstrate a perfect agreement of the Cape system with the Harvard photographic system. Comparisons between the photographic and visual magnitudes lead to the conclusion, also in agreement with the Harvard results, that the "colour" of the stars is a function of their brightness, faint stars being slightly redder than bright stars. This fact is tentatively attributed to the existence of absorbing matter in space. The phenomenon is emphasised in the regions of the galaxy. It is also found that, on the average, stars are actinically brighter in the Milky Way than in other regions.—W. A. **Jolly**: The electromotive changes accompanying activity in the mammalian ureter.—I. B. Pole **Evans**: A new aloe from Swaziland. A new species of aloe, found in Swaziland by Mr. R. A. Davis in June, 1914, was described and named *Aloe suprafoliata*. It may be recognised by its distichous leaves, which are rigid, somewhat fleshy, and patent or gracefully recurved. The flower spike is slender, unbranched, and bears rather loosely-attached rose doree flowers. The plants are usually found on the tops of quartzite kopjes, and have been found at Stegi, Lebombo Range, and Forbes Reef.

CALCUTTA.

Asiatic Society of Bengal, August 4.—S. C. **Mitra**: North Indian charms for securing immunity from the virus of scorpion-sting. Charms which are popularly supposed to render the user thereof either invulnerable to the stings of scorpions or immune from their virus, *e.g.*:—(1) By the repetition of certain passages of the Koran; (2) by performing the fire-walking ceremony known as *Dam madār;* and (3) by carrying about one's person the medicinal plant known as the *Chirchirā* (*Achyranthes aspera*). The author also described the preparation and discussed the origin of a curious cognate charm whereby a practitioner acquires the power to cure scorpion stings, after rubbing with his hands, while he is in a blindfolded state, the blossoms of a mango tree.—I. H. **Burkill**: The Terai Forests between the Gandak and the Tista.—Dr. N. **Annandale**: The origin and distribution of the fauna of the Lake Tiberias. The aquatic fauna of the Jordan river-system, and in particular that of the Lake of Tiberias, consists mainly of species belonging to Palæarctic genera, and closely allied to, if not identical with, forms from eastern Europe or from the Euphrates Valley. There are, however, a certain number of animals that are Ethiopian either in genus or species. It is a remarkable fact that the distinctly Ethiopian forms are all fish. There are a considerable number of endemic species in the Lake of Tiberias, but none of them are very highly specialised. The only endemic genus is the sponge Cortispongilla. The presence of African fish can only be explained by a former connection through the south of the system with the "Erythræan River" of Gregory, which received a tributary from Central Africa. The fish of African origin all belong to families and genera that are particularly suited to survive unfavourable conditions. The view is put forward that they have been able to survive great changes of salinity in the water of different parts of the Jordan system, while any African invertebrates that may have made their way into it have perished, with the possible exception of a few very widely distributed mollusca (such as *Melania tuberculata*) and other forms that exist in tropical Asia as well as in Africa.—S. C. **Banerji**: A botanical curio. A huge epiphytic *Ficus bengalensis*, L., on a tall *Borassus flabellifer*, L., is to be found in the village Barā on the way to Pāthrole from Madhupur (Sonthal Parganas). The two together appear to be a composite tree. One-half of the height of the palm from the ground, excepting a small portion at the base, is completely encased by the root of the fig. The persistence of the epiphytism is interesting.

BOOKS RECEIVED.

Canada. Department of Mines. Geological Survey. Memoir 69: Coal Fields of British Columbia. Compiled by D. B. Downing. Pp. iii+350. (Ottawa: Government Printing Bureau.)

Identification of Common Carbon Compounds. By J. N. Rakshit. Pp. iii+222. (Calcutta: *Collegian* Office.)

Applied Immunology. By Drs. B. A. Thomas and R. H. Ivy. Pp. xv+359. (Philadelphia and London: J. B. Lippincott Co.) 16s. net.

British Rainfall, 1914. By Dr. H. R. Mill and C. Salter. Pp. 448. (London: E. Stanford, Ltd.) 10s.

War Plants or Products of Intensive Kultur. By C. H. L. Woodhouse. Pp. 24. (London: G. Routledge and Sons, Ltd.) 6d. net.

The Hundred Best Animals. By L. Gask. Pp. 304. (London: G G. Harrap and Co.) 7s. 6d. net.

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